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SCIENTIFIC AMERICAN

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ENGRAVING SPY MESSAGES ON THE HEAD OF A SHOENAIL FOR THE MICROSCOPIC EYE.—[See page 398]

Scientific American Publishing Co., Munn & Co., New York

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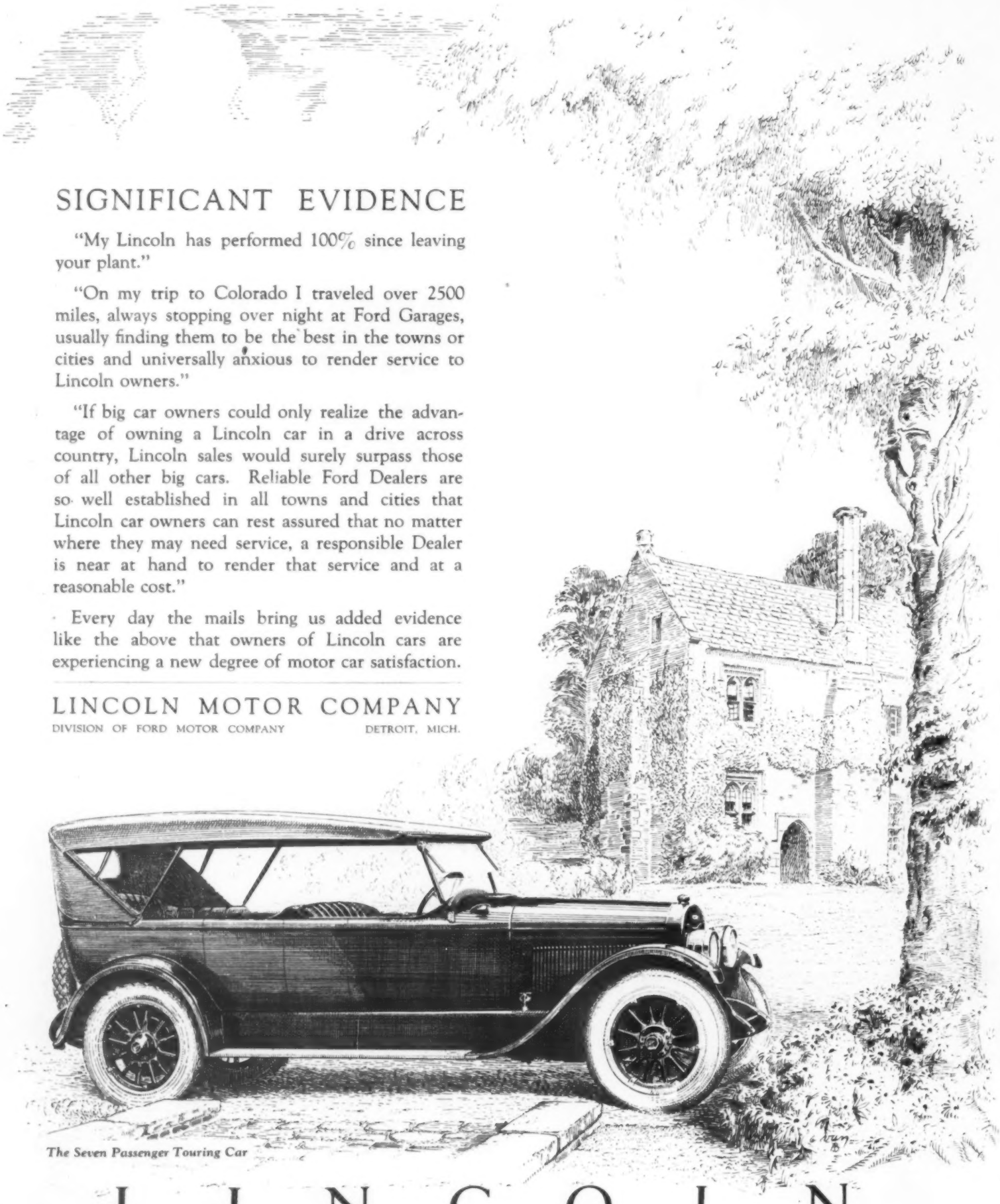
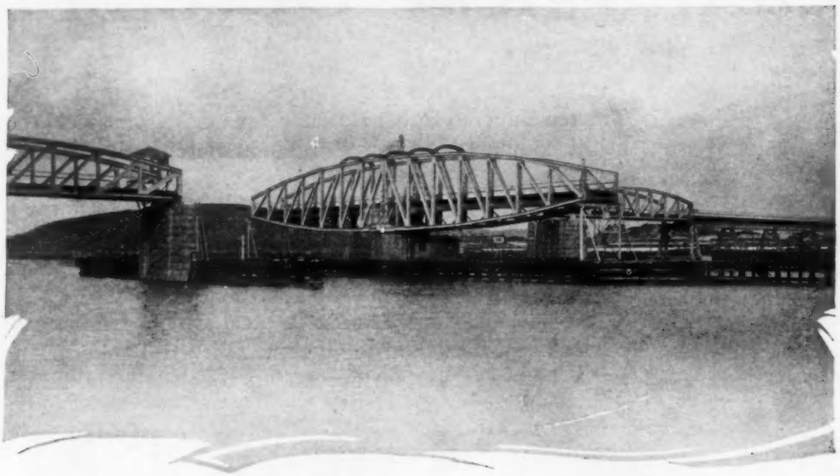


The Seven Passenger Touring Car

L I N C O L N

Vol 128-No 6

SKF



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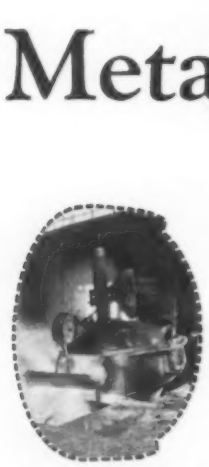
Normal View *Deflected View*

BALL BEARINGS
The Highest Expression of the Bearing Principle

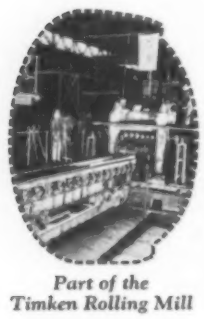
THE SCIENTIFIC AMERICAN, June, 1923. Volume 128, Number 6. Published monthly by Scientific American Publishing Company, at 233 Broadway, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

Timken TAPERED ROLLER BEARING Steel

A Metallurgical Development



One of the Electric Furnaces

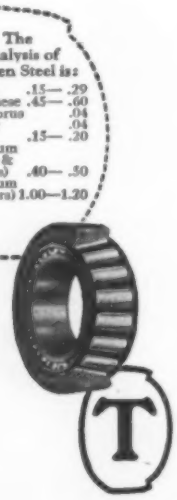


Part of the Timken Rolling Mill

In the Timken Tube Mill

The Analysis of Timken Steel is:

Carbon	.15— .29
Manganese	.45— .60
Phosphorus	.04
Sulphur	.04
Silicon	.15— .20
Chromium (Cups & Cones)	.40— .50
Chromium (Rollers)	1.00—1.20



Timken Tapered Roller Bearings are made from steel produced in the company's own steel mill—in Heroult electric furnaces.

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Tapered
ROLLER BEARINGS

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That is one of the reasons why Timken Tapered Roller Bearings are known for their durability in the hardest kind of service—with many records of from 200,000 to 500,000 miles of service in automotive vehicles, and equivalent service records in industrial machinery where speeds are often as high as 10,000 r. p. m.

The Timken Roller Bearing Company is the only bearing company which makes its own steel, and its own seamless tubes, and rods, in its own electric steel mill, rolling mill, tube and rod mill.

The Timken Roller Bearing Co
CANTON, OHIO

**Send for paper by Timken metallurgists read before the Iron & Steel Institute of London, England, "Influence of Dissolved Oxides on Carburizing and Hardening Qualities of Steel."*

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With the Editors

H. G. WELLS, in an article entitled "What Everyone Should Read" appearing in the May issue of *The American Magazine*, has a kind word for us which we cannot resist passing on to you. The great British historian and novelist says, in part: "Everyone, I think, should read such a weekly newspaper as *Nature*, of London, within its range the most honest and wonderful newspaper in the world, or the SCIENTIFIC AMERICAN to keep in touch with the ever-advancing boundaries of human knowledge and achievement. If there are people who cannot read such periodicals, then it is high time the schools that produce such people were looked into and shaken up to a higher level of efficiency. When I write of what everyone should read in modern community I have, of course, to assume that the schools of that community have prepared them for their reading."

INCIDENTALLY, we might add that our London contemporary, *Nature*, is one of our most valuable exchanges. Each issue is carefully gone over for the purpose of giving our readers the choicest information which it contains, in the form of abstracts. This British journal must not be confused with another excellent journal called *La Nature*, which is printed in French and published in Paris, and which is often quoted in our columns. And if we are to stretch out this list of foreign journals which come to us regularly, we may add two interesting German periodicals—*Die Umschau* and *Kosmos*. It so happens that all these various journals are of the popularized science sort, and like the SCIENTIFIC AMERICAN they are dedicated to chronicling the advancement of pure and applied science. Quite often our exchange editor notes an interesting illustration and an attractive title, and begins reading an article in one of these foreign contemporaries. He becomes quite interested. He believes this article could be translated and abstracted for our own columns. Then, suddenly, he comes across the credit to the SCIENTIFIC AMERICAN, indicating that the article or idea originated with us. It is quite bizarre how another language changes an idea or article, more so when German script or some other odd type is used. We often find ourselves reading our own articles in foreign dress, without realizing they are ours.

FROM Edward H. Benjamin in California comes an interesting letter telling of his early experiments in telephony. "It may or may not be of interest for you to know that I made the first two telephones ever made and used in the State of California from a description I read in the SCIENTIFIC AMERICAN, in 1876. They were very similar in form to the present receiver and were connected and used through a coil of two miles of wire in my home in the mission and were the wonder of the neighborhood at that time. They were also connected up and used on the private wire of the old California Pacific Railroad, now the Southern Pacific, between their West Oakland shops and the general office in San Francisco, through a cable that ran under San Francisco Bay."

THE second report of our European psychic investigation appears in this issue, dealing this time with the psychic photographs produced by the British medium Hope. Because of the widespread interest in the psychic photograph made for our investigator, Mr. Bird, we decided to publish this report at this time, even if it is out of the chronological order in which the investigation was conducted abroad. Meanwhile we have the definite assurance of seances under our own test conditions and in our laboratory during the month of May. It will be interesting to note what effect the rigid scientific controls have on psychic phenomena, especially in view of the experiences of the Seybert Commission in 1888 and the Leland Stanford investigation of more recent date. Past experiences would indicate that psychic phenomena become increasingly less with the building up of scientific controls. At any rate, we again wish to state emphatically that Mr. Bird's investigations both in Europe and in the United States, thus far, have been carried out only in his capacity as a careful observer: he is stating his impressions and not those of our judges at this time. He has had little if any opportunity to exercise rigid control during the seances. It remains for our own seances, carried out on truly scientific lines and under the guidance of our board of judges, to establish the positive genuineness of psychic phenomena.

AMONG the interesting features in our forthcoming July issue we have a comprehensive account of the industrial Philippines. It appears that the economic progress of the Philippines since American occupation twenty-three years ago, is infinitely more vast than the three centuries preceding it. The American occupation has been marked by the extension of operations, greater and more standardized production, modernization of processes, and greater co-ordination in management and marketing. The Philippine group comprises 7000 islands; there are 6000 miles of good roads; 9000 miles of telegraph lines and 900 miles of inter-island cables ensure rapid communication between the isles. There is a real story to tell with regard to the industrial Philippines, and it is a Filipino, Mr. Vicente Villamin, who tells the story in our July issue.

ALWAYS we have with us the members of the gentry who, by violence or through the exercise of some manner of light-fingered finesse, seek to possess themselves of their neighbor's goods without going through the formality of payment. The series in which Mr. Edward H. Smith has been telling us of the wiles of these folk, and of the means used to checkmate them, has aroused such interest that we are carrying it beyond its originally intended limits. This month Mr. Smith tells us something of how the automobile thief works; and next month he describes some of the traps that have been set to catch the burglar at his work.

HOW bridges can tell us their ailments by means of photographic apparatus; how granite and marble are carved and finished by means of abrasives with no more effort than the shaping of soft wood; how shot is manufactured by means of the picturesque shot tower; how corn plays an important role in our national prosperity; how radio is affected by summer weather and what can be done to alleviate that radio *bête noir* called static; how building methods have been simplified to combat the high prices of materials and the high wages of the building trades on the one hand, and how shoddy methods have come into existence in the building of speculative homes—these are but a few of the features of our July issue.

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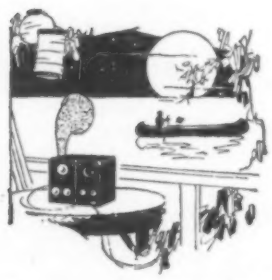
For Summer Sport —Radiola RC

Radiola RC
Solid mahogany; complete with three tubes, six batteries, headset and plug—
$142.50

The porch sewing circle listens in, with Radiola RC. Probably a fashion talk.



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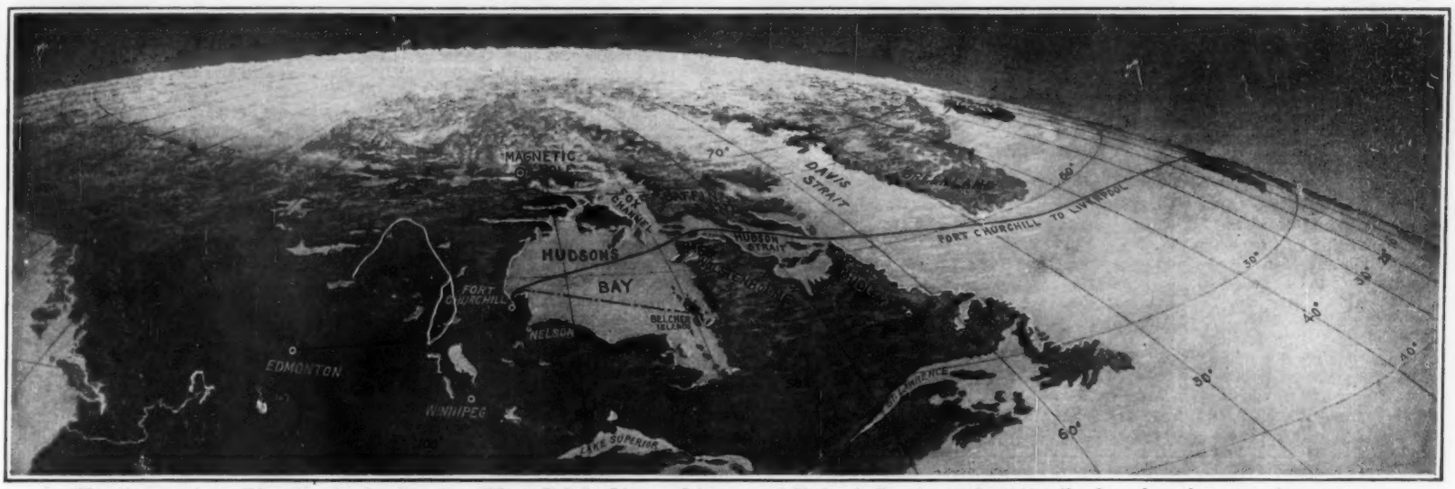
SEVENTY-NINTH YEAR

SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, JUNE, 1923



The distance from Edmonton in the Canadian Wheat Belt to Liverpool by way of Hudson's Bay is nearly 1000 miles less than that over the present St. Lawrence route

Hudson's Bay, the "Neglected Sea"

By John T. Rowland

WHEN Henry Hudson in 1610 discovered the great bay that bears his name he opened the way for one of the earliest trade routes in America. In 1668-1669 the ship "Nonesuch" of the "gentlemen adventurers" made a voyage of exploration into the bay; and the following year Charles II. granted a royal charter which gave them the sole trading rights for the greater part of what is now the Dominion of Canada. By this act the Hudson's Bay Company came into existence, and from that time until the present day its ships have been persistent voyagers upon that immense but seldom considered inland sea. Except for an occasional whaler or the small vessel of some daring independent trader they have had it all these years practically to themselves; but now, *presto*, the whirligig of time suddenly bids fair to exalt this veritable *mare clausum* to its proper place as one of the three great trade-ways into the heart of the American continent—the other two being the Mississippi River and the Great Lakes system.

The reason for this is not any change in Hudson's Bay itself. The controlling factor as usual is economic: it has dawned upon the minds of our neighbors across the border that here is a ready-made sea route lying wholly in Canadian territory and extending to within a few hundred miles of the great wheat exporting belt of the Canadian Northwest.

In the summer of 1911 I cruised the length of Hudson Strait (which connects the bay with the Atlantic Ocean) in a 30-foot auxiliary yawl and afterwards came out in the Hudson's Bay Company's supply ship "Pelican," a fine old steam bark which had been making her yearly round from England to the various posts on the bay almost without mishap for some thirty-odd years. It struck me then as nothing less than amazing that no real effort had been made to develop that route for general commercial purposes. The distance from Liverpool to Edmonton by way of Hudson's Bay, including an overland haul from Fort Churchill on the west shore of the bay, is nearly 1000 miles less than that over the present St. Lawrence route via Montreal. Moreover, the opening of a new gateway to the Northwest would afford greatly needed relief for jammed terminals during the comparatively short period when most of the Canadian wheat is shipped out. And besides that, it would form an all-sea route, without locks or canals, for the carrying of all manner of freight in either direction during the open season. Fort Churchill is actually further west and very much nearer the new lands of Alberta and Saskatchewan than is Duluth, at the head of the Great Lakes system.

In brief, the opening of an established trade route to Hudson's Bay would give interior Canada a seacoast and would bring it almost as near the European market as are the so-called Maritime Provinces.

At first glance this may appear incredible, but a little study of the accompanying map will show that it is quite true. Owing to the fact that England and Canada both lie in comparatively high altitudes—mainly north of 50 degrees—the meridians of longitude are brought close together, and the actual distance in *miles* between 0 degree and 95 degrees west longitude, in the higher latitude of Churchill on Hudson's Bay, is not much greater than that between 0 degree and 65 degrees west in the more southerly latitude of Nova Scotia. This fact is not apparent in a map made on a Mercator projection, but it is very evident upon a globe or on a bird's-eye view like the accompanying one which preserves the true proportions of the earth's surface.

At the time which I have mentioned (1911) there was no railroad within several hundred miles of Hudson's Bay. The company's people at Churchill and Nelson had to travel long distances by dog sled if they wished to go to Canada, and most of them, as a matter of fact, preferred to come out in the company's ship, which went direct to England. All the Hudson's Bay region was as completely cut off from the well-settled parts of Canada at its back door as though it existed on a different continent.

Now all this is likely to be changed by the pressure of wheat. Today the various problems connected with the "Hudson Bay route" are giving rise to much the same sort of controversy throughout Canada that the relative merits of the Panama and Nicaragua routes for a canal caused in our country two decades ago. A considerable portion of the steel has already been laid to the bay. Parliament and engineers are disputing the rival claims of the adjacent ports of Nelson and Churchill as terminals; while there is a strong conservative party, as there always must be, which proclaims the entire project chimerical.

Indeed, the difficulties of such a route are sufficient. The railroading end of it is perhaps the simplest, although that will involve the outlay of millions in laying a firm underpinning for the roadbed across the almost bottomless muskeg swamps. Add to this the cost of creating a port, with docks, yards and terminal facilities, and you have just come to the place where more difficulties, the maritime, begin.

The whole western half of the bay lies so near to the earth's north magnetic pole that the mariner's compass is practically inoperative in this region. One night when I was on board the "Pelican" not a single one of her three compasses would function. The steering compass was 90 degrees out and swinging slowly to the right; the one on the bridge was revolving in the opposite direction; and the "standard" compass—placed on the top of a 12-foot pole in order to raise it above the magnetic influences of the ship—was chasing its tail first one way and then the other.

"In a case like this," said the "Pelican's" master dryly, "a chap has to know how to lay a course by the stars."

"But suppose it's overcast, or blowing and snowing?" I inquired.

"In that event you smell your way like a seal."

Precarious navigation—to say the least!

But this difficulty has since been almost magically removed by the perfection of the gyro-compass. A ship equipped with one of these can dispense with the old-fashioned magnetic instrument entirely and steer across Hudson's Bay as readily as across the Atlantic Ocean.

Strong tidal currents are another bugbear, especially in Hudson Strait, where in places a spring range of over 40 feet has been recorded. On one occasion, in the auxiliary yawl before-mentioned, I found myself carried 20 miles out of my course in an overnight run across the strait. Naturally this would constitute a great peril to a large ship in spite of the fact that the shores are bold and the waters of the strait remarkably

(*Continued on page 417*)

Your Automobile and the Thief

Another Phase of the Constant Battle Waged Between the Lawful Owner and the Skillful Criminal

By Edward H. Smith

MADISON Square Garden, that resounding edifice in whose historic girders and timbers lurk the echoes of New York's wildest revelry, was crowded to the roof for a prizefight. Inside there was no more than breathing space for fifteen thousand enthusiasts. Outside, in all the surrounding and confluent streets, stood a thousand motor cars, attesting the prosperity of many of those who sweated and roared with the clamant mob at the arena. Policemen passed up and down the long, close-packed lines of cars; chauffeurs waited, dozing in their seats; the usual night-flow of pedestrians meandered by. Yet when the great gates of the hall were opened and the crowd came bellowing forth from its gory pleasures, 45 automobiles were missing—stolen within three hours, under the noses of scores of watchers in the bright center of our greatest city.

This happened early in the spring. The following Sunday was full of nascence and sunshine. Thousands of cars that had been stored for the cold months, came forth from their garages and all the streets and outlying roads of New York were dark with the never ending columns of motors, running out to the suburbs in quest of the first fragrant air of April, or rolling back from the villas and roadhouses along the way. On this occasion 37 cars disappeared in the course of the afternoon and evening—another fine harvest for the thieves.

Heavy chains and steel cables may protect the extra tire against the sneak thief but not against the professional operator

These are mere local samples—incidents in the nationwide campaign of the criminals against the owners of the cars and the companies which insure us against these innumerable and irrepressible robbers. A better view of the problem put upon the people by these lawbreakers can be got from estimates of motor stealing covering the entire country.

It is estimated by the National Automobile Dealer's Association that 35,333 cars were stolen in 28 principal cities of the United States in 1922. Their least value is thirty-five millions of dollars. These general figures need some explanation.

In 1921, when ex-Governor Whitman was conducting a legislative inquiry into the police administration of New York City, he published figures showing that 9000 motor cars had been stolen in Greater New York in the course of 1920. Later in the year the State of New York, through its license bureau, caused compilations of a similar nature to be made in order to find a basis for legislative action against the automobile thief. The State experts concluded that only about 7000 cars had been stolen in the entire State in 1920 and that about half of these had been recovered. As to recoveries, Mr. Whitman and his assistants were agreed in the sense that they, too, recorded the recovery of somewhat less than half of the cars.

The figures of the National Automobile Dealer's Association agree closely with those of Mr. Whitman. According to these authorities, about 25 cars are stolen in the metropolis daily. Of these about half are eventually recovered by the police or other law officers. The rest never come back. In addition, many of the recovered cars are taken from owners who have bought them in good faith and paid the thieves sound money for them. Still others are got from fences and corrupt sales agents who have bought them from the original thieves for low cash prices.

The same authorities tell me that the losses of cars in such cities as Chicago and Detroit have been notoriously heavier, considering population, than in New York City. In California, also, the thieves are said to have done heavy execution and recoveries are said to be even lower in the West than in the great eastern cities.

Accordingly, these final estimates are made:

Cars stolen in New York State in 1922, at least 10,000.

Cars stolen in the United States, at least 35,000.

Recoveries for New York State, about 5000.

For the United States, 15,000.

Net national stealage of cars, 20,000 a year.

Since the average annual output of pleasure vehicles, based on the records of the last five years, is about 1,500,000, the stealage figures at about two per cent. It may, however, be calculated differently on a basis of the total number of motor vehicles of all types in existence in the country, about 10,500,000, according to the reckoning of the automotive industry. In this case the ratio of theft is less than one-third of one per cent. However, there are two objections to this method of computation: first, the total number of cars is more or less fixed, while the number of cars stolen must be subtracted each year; again, the commercial vehicles included in the manufacturers' total figure only very slightly in automobile stealing. But—every man to his own arithmetic after his own tastes!

A great effort is being made in all parts of the country to balk the motor thief and his accessories and colleagues. Naturally, neither the manufacturers, the owners or the insurers want to continue any drain of thirty-five millions a year, plus the vast expense of guarding against, hunting, detecting and prosecuting thieves and recovering stolen cars. The defensive campaign has fallen into the hands of three agencies—the manufacturers of cars, the insurers, and individual inventors of anti-theft devices.

Manufacturers lately have been taking two methods of precaution: first, the employment of various types of car locks produced by their own or independent inventors; second, the stamping of various sets of serial numbers on many parts of their cars. Until a few years ago cars were turned out without locks or other anti-theft devices. And even more recently many makes of cars had only two identifying numbers, one on the motor and another somewhere on the body. The thieves naturally knew where these numbers were to be found and readily changed them by employing sinking dies exactly like those used by the motor companies. In many cases the thieves did not even trouble to file or eat off the original numerals with acid. Instead, they resorted to the quick and easy trick of changing the figures 1 and 3 and sometimes 6. A die with the numeral 4 was simply superimposed over the 1 and an impression hammered into the iron or steel. Likewise the 8 was imposed over the 3 or 6. Thus a car with the serial number 321,569 was very rapidly changed to 824,589. Close examination, especially with an enlarging glass, is, however, able to detect such alterations and the thieves have generally abandoned this trick and taken to eating the original numbers off with acid and then cutting an entirely new set. I am told that this kind of alteration is extremely difficult to prove.

Copyright, Keystone View Co.

This simple spiked band, locked around the tire and wheel, affords an excellent protection against the ordinary automobile thief

Accordingly, the manufacturers of most standard cars have, for the last several years, put from eight to a dozen numbers on various parts of their machines. In most of the better makes of machines today, there is at least one secret number, hidden where neither the police nor the thieves are likely to guess, and known only to the manufacturers and the trusted adjusters of the insurance companies. Moreover, the hiding places of these secret numbers are changed from time to time to prevent their discovery. This precaution has already done a good deal to aid in the recovery of the cars stolen and altered as to numbers by the thieves. It has also been of value in proving larceny against thieves, fences and dealers in stolen machines.

But, in spite of these expedients of other car makers, the most widely used and largely stolen of all machines, the Ford, still has but one set of numbers and continues to be unidentifiable, once the criminals have had a chance to work on it. In this connection a certain New York business man recently taught both the thieves and the officers of the law something worth remembering.

This man, whom I shall call Jones, had just bought a new Ford sedan. Two weeks later it was stolen. Still later the police and the insurance adjuster recovered a batch of stolen machines, among them a Ford sedan which had been driven only a few hundred miles. Mr. Jones was notified and went to identify his car. Other owners were present when he arrived, as were half a dozen experts. All the trained men looked the sedan over very carefully, studied the altered number with close attention and agreed unanimously that the sedan was one which had been stolen from another man, Mr. X. Three independent examiners concurred in this view and finally Mr. X himself stated that he was able to identify his car by certain peculiarities which he enumerated. So that ten men were utterly positive that the car belonged to X.

All this time Mr. Jones was protesting as best he could. In spite of the opinions of Mr. X and the learned experts he was certain that the car was his. Might he examine it inside? He did so and came out of the car with a proposition.

"Gentlemen," he said. "I'll prove to you in one minute either that this is mine or is not. Has anyone a screwdriver?"

He was handed that ordinary tool. At the same time he took out his card case and handed the chief detective a bit of pasteboard.

"There's my business card," said Jones. "Do you mind hanging on to it for a minute."

The wondering officer took the card and held it. Jones got into the sedan; took out four or five tacks from the upholstery tape at the side of the rear seat, pulled back the leather, reached his hand and forearm down into the padding and brought forth a card. He handed it to the detective with an air of triumph.

"Is the car mine?" he demanded.

"Well," said the mystified officer, "I suppose——"

"No supposing to it," interrupted Jones. "I thought someone might steal my car, so I opened up the upholstery, put my business card in there and then tacked it down again."

He got his car back and the ten witnesses may have profited by this lesson in the worthlessness of ordinary identification.

The insurance companies have dealt with the matter of motor theft by reframing their policies to discourage collusion between car owners and professional thieves. It is a notorious fact that a very large percentage of the losses formerly paid by the insurers covered either apparent or suspected cases of conspiracy. This was especially true of motor accessories, such as spare tires, robes, horns and other costly special equipment. Undoubtedly a great deal of such material was actually pilfered by the minor thieves and street arabs, and especially by the dishonest employes and patrons of garages; but it was also a fact that motorists who lost second-hand or almost decrepit tires and other accessories, always put in claims for new articles of the most expensive type. Accordingly, the insurance companies, without any exception known to this writer, now refuse to insure accessories at all. At the same time they have made radical changes in the regulations governing the insurance of cars.

Formerly an owner who bought a car for $5000, let us say, took out a policy for the full amount. If his car was stolen at any time in the next year he claimed and got $5000, the face value of his policy, in spite of the fact that such a car, used for 11 months, for instance, is worth no more than $2500 or $3000 in the second-hand market. Naturally, it was a great temptation to unprincipled owners to have their cars stolen or done away with just before the end of the year. The trick, if successfully accomplished, meant a brand new car without a dollar's outlay.

Even worse abuses were very common. A man had an old rattletrap which had cost $3000 four years before. He got it repaired and repainted. Then he sold it for $2000 to someone who was in league with him. Next, an insurance broker was called in and asked to write a policy covering the car for this amount. The broker cared more about his commission than about the honesty of the transaction, and wrote the business. Unless the insurance company should happen to be especially watchful, the risk stood accepted. A few months went by and the poor old bonerack was stolen and could not be found. The insurance company paid $2000, with which the owner was able to buy himself a first rate new car.

Every community knows about the graveyards of these collusively stolen vehicles. Near Los Angeles the police dragged a number of derelict cars from the Pacific. In San Francisco many others were found at the bottom of the bay. At Chicago, Toledo and Cleveland the skeletons of these sad castaways have been grappled out of the lakes; and in New York the police have found several such motor necropoli in the East River, the Hudson, the Harlem, the Sound, Jamaica Bay and elsewhere.

But only a very small percentage of the cars stolen with the knowledge and enthusiastic consent of their owners ever find their way to such ruinous ends. Usually a very nice arrangement is made between the owner and the professional thief. The latter comes and drives away the car, while the accommodating owner waits for hours or over-night before reporting his loss. Naturally, the chance of catching the thief or recovering the car is then very small. The thief disposes of the car for what he can get and the owner keeps the insurance.

To break up this practice, the insurance companies have, since the latter part of 1921, issued policies which do not permit of the payment of the face value. Instead, there has been substituted what is called a replacement clause. By its terms the owner who loses a car by theft does not get the cash but must accept from the insurers another car of the same make, type, body and general date as his own, as revealed by the serial numbers. In other words, if you buy a Blank touring car of the 1923 model, serial number 999,999, and the car is stolen a month or several years later, you must be satisfied with another car of the same kind, serial number 999,998, perhaps, or 1,000,001.

Motor car owners will be familiar with all this and they may be interested in recent decisions of the Supreme Court of New York, which tend to upset this practice of the insurance companies. In at least one recent case the court decided that, as the car was insured for $3000 and the premium had been paid for that amount of coverage, the insurers must pay $3000 and not evade their responsibility by offering a used car worth less than $2000. This holding is in consonance with the general attitude of juries in similar insurance matters, since they usually decide that a man who pays an insurance premium is entitled to the amount he paid for, or, at least, the amount for which the insured article may be replaced new. Whether the higher courts and the judicial bodies of other states will uphold this view has yet to be seen. It remains a fact, however, that the right of insurance companies to enforce such regulations against their clients is in grave doubt.

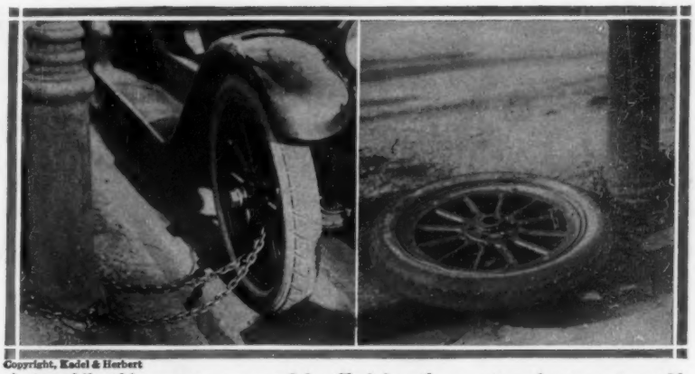
Finally comes the romance of the inventor and the thief, once more a chief focus of interest in the war between criminals and honest men. Inventors have generally applied themselves to the idea of developing various locks to render impossible the removal of cars from garages or from the streets, where they have been left standing. Here the fundamental fault is a very old one. Locks are made to be opened, and nature has so ordered things that what one man can do with the proper instruments in all honesty, another may accomplish by false and wrongful means. The old story of safe locks and bolts gives eloquent testimony here.

The locks now generally employed are of two general kinds—those applied to the steering post and those on the transmission. Without going into details, it may be said that all the standard locks of either type are worth having. To some extent they prevent theft, but they are not absolute protection or anything like it. If a gang of well prepared thieves is determined to take your car, no known lock will prevent it. In every city, in the land the gangs of automobile robbers have repeatedly carried away locked cars in tow behind other machines. Again, where the wheels were locked, the robbers have often arrived with a repair car, derricked the locked machine into a truck and made off with it. Usually such things can only be done at night; but nevertheless they prove the general contention that locks do not stop theft.

Many other curious types of thief foilers have been evolved. One of my friends has produced a siren or squawker which connects under the driver's seat. On leaving the car the owner turns a hidden switch and the protective device is ready for action. If a thief gets into the car with the intent of driving it off, the pressure of his weight on the cushion releases the switch and the horn begins to clamor and snort without ceasing. Still another acquaintance patented and has been selling a device which throws a strong light as soon as the thief gets into the car and starts to operate it. This is supposed to be specially useful at night, when most cars are stolen. And a third gentleman of high purpose has perfected a device which attaches to the spare tire rack. If anyone but the owner tampers with it and tries to remove the tire, the horn is put into action and a terrifying noise results.

The trouble with all these devices is that they depend for their efficiency on the element of surprise or, better said, on the thief's ignorance. For, if the robber knows that such an alarm is present on the car, he can easily detach it and have his choice of things. The unfortunate fact is that thieves are thoroughly posted on all these matters—lack of information is fatal to their

(*Continued on page 417*)



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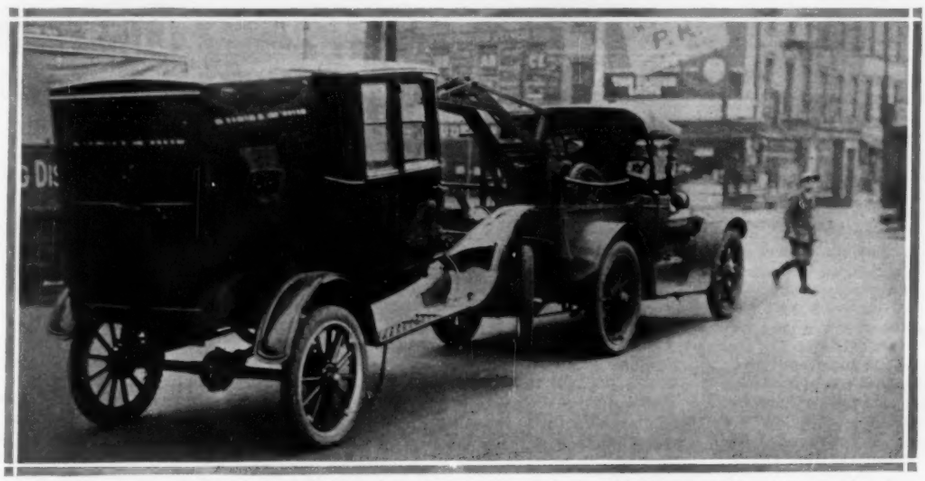
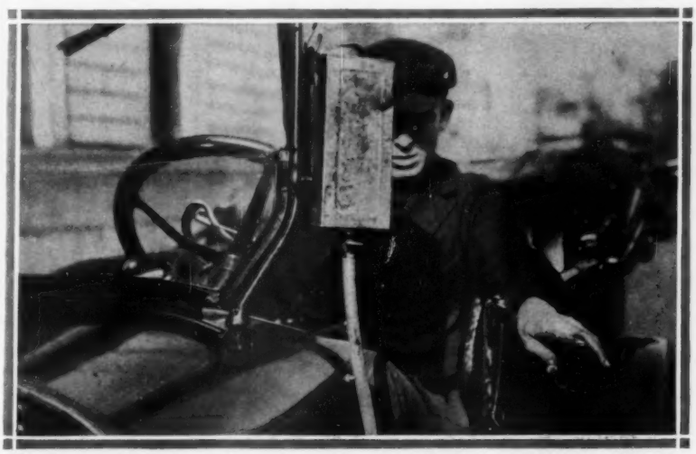
Automobile thieves are resourceful. Chaining the car to a lamp post would seem ample protection. Yet the pictures tell the story



Locked steering wheels or transmissions afford some protection. But the professional band of automobile thieves take care of such cases in the manner here shown

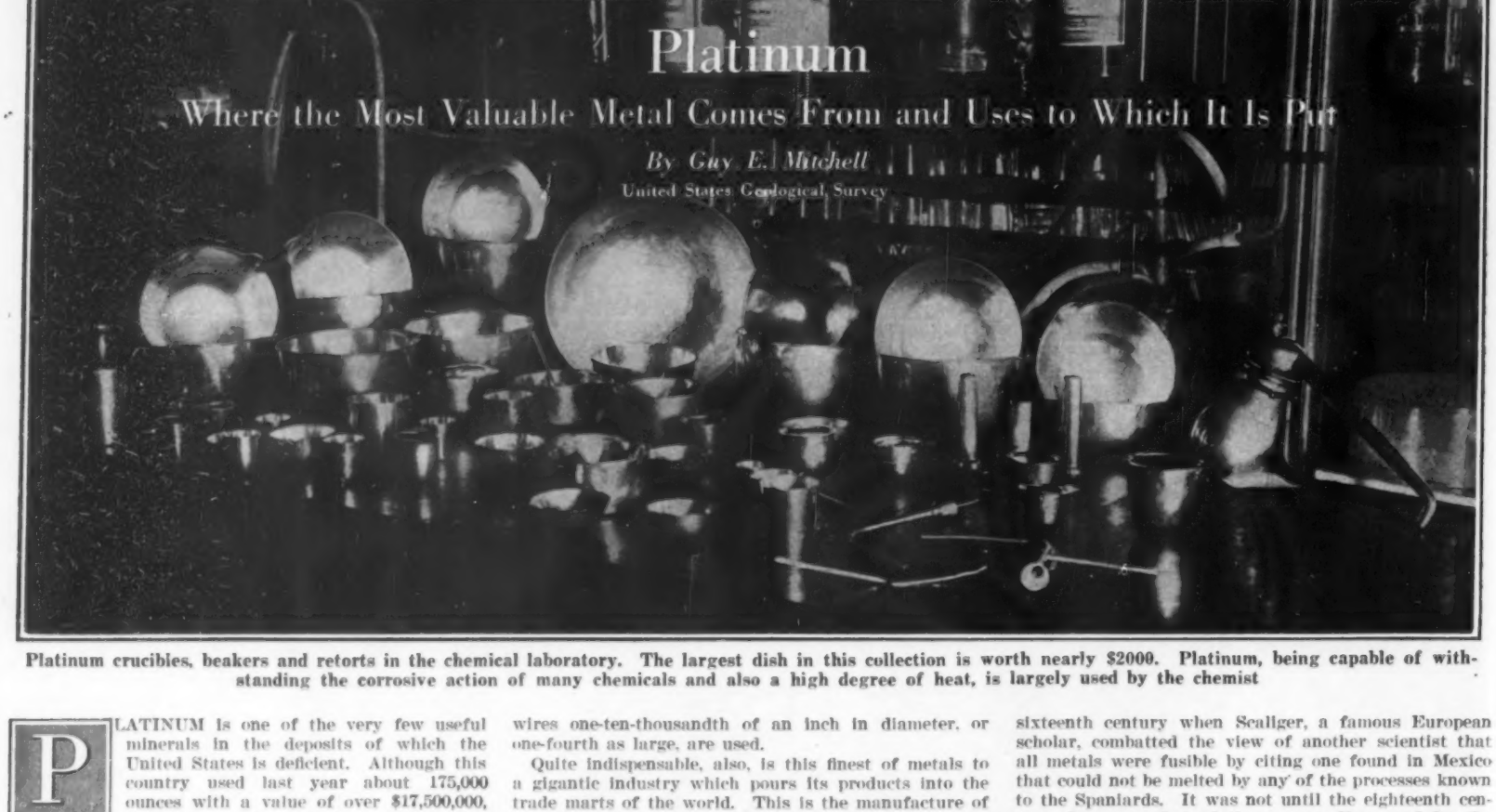


Gasoline supply locks and secret gasoline cut-offs are a protection against the inexperienced thief. The professional uses his own tank

Platinum

Where the Most Valuable Metal Comes From and Uses to Which It Is Put

By Guy E. Mitchell
United States Geological Survey



Platinum crucibles, beakers and retorts in the chemical laboratory. The largest dish in this collection is worth nearly $2000. Platinum, being capable of withstanding the corrosive action of many chemicals and also a high degree of heat, is largely used by the chemist

PLATINUM is one of the very few useful minerals in the deposits of which the United States is deficient. Although this country used last year about 175,000 ounces with a value of over $17,500,000, the amount mined in the United States was only a thousand or so ounces. This, in spite of the fact that because platinum is a necessity in modern fighting, every nook and corner of the remotest wilderness in the United States has been explored and ransacked for new platinum deposits during the past few years.

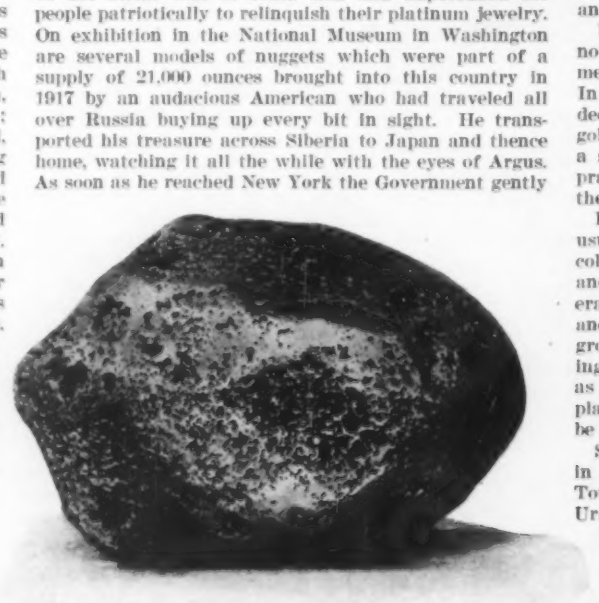
The story of platinum is unrivalled in interest even by the unending romance of gold which has played such a vital part in the history of the world for six thousand years or more. Gold has brought happiness and has caused despair to millions of men and women; it has made powerful nations on one hand and has ruined entire nations on the other; it has caused delight and anguish throughout the ages. Its less obtrusive sister, platinum, has remained quietly at home during all this period; indeed, a Cinderella of metals, all but unrecognized, yet almost as beautiful, far more useful, and possessing qualities of sterling worth and merit never dreamed of for its more brilliant companion. Now it has come into its own, and platinum coins are no longer plated with gold, for the coating of gold debases the platinum.

Everyone has seen the exquisite effects obtained when platinum is used as a setting for diamonds and other gems, but even today comparatively few realize its commanding value in the chemical arts and sciences. In the laboratory it is a priceless article, and since the laboratory is the experimental ground of big business, it follows that platinum enters largely into the world's economics. Civilization could well go on without the dazzling ornaments of the jeweler's craft, but the progress of chemistry would be seriously hurt were the wizards of this exact science deprived, for instance, of platinum crucibles. Crucibles of porcelain and other non-malleable substances break down under the fierce heat of the modern electric furnace, as do those of gold and silver, which melt at a thousand degrees less than platinum; but this regal white metal will withstand terrific temperatures and come forth unharmed. The platinum cup or crucible, hammered out almost as thin as paper, will grow incandescent but will not even soften while its contents are being dissolved at a temperature of 3000 degrees Fahrenheit, nor is it affected by the action of the most powerful chemical reagents which attack other metals.

So unbelievably ductile, too, is platinum that a single ounce may be drawn out into a wire, invisible to the naked eye, which would reach more than half way across the United States. The finest spiderwebs are one-five-thousandths of an inch in diameter, and these were formerly used as cross-hairs in the most delicate and precise telescopic instruments. Today, platinum wires one-ten-thousandth of an inch in diameter, or one-fourth as large, are used.

Quite indispensable, also, is this finest of metals to a gigantic industry which pours its products into the trade marts of the world. This is the manufacture of sulfuric acid, a product of prime importance in times of peace, but of absolute necessity in war for use in the making of explosives. Platinum used in minute quantities will in miraculous manner transform the compounds which make sulfuric acid, but will itself remain unchanged.

Whether the statement so frequently heard that "platinum won the war" was a bit extravagant, the fact remains that the United States commandeered all of the metal that it could find and importuned the people patriotically to relinquish their platinum jewelry. On exhibition in the National Museum in Washington are several models of nuggets which were part of a supply of 21,000 ounces brought into this country in 1917 by an audacious American who had traveled all over Russia buying up every bit in sight. He transported his treasure across Siberia to Japan and thence home, watching it all the while with the eyes of Argus. As soon as he reached New York the Government gently



Six-pound nugget of platinum, shown natural size. This piece of metal is worth nearly $10,000

took over the metal, worth at the time some $2,000,000. From it was made the infinitely slender wire used by the Ordnance Department in manufacturing explosives.

The ancients knew a good deal; they not only worked extensively in gold and silver and copper, but that they knew how to reduce platinum is shown by the discovery at Thebes some years ago of a curious Egyptian box thousands of years old, made of an alloy of gold, platinum and iridium. But this peerless metal seems to have been lost to the world until sometime in the sixteenth century when Scaliger, a famous European scholar, combatted the view of another scientist that all metals were fusible by citing one found in Mexico that could not be melted by any of the processes known to the Spaniards. It was not until the eighteenth century, however, that platinum was discovered by the modern world. Antonio de Ulloa, a Spanish naval officer who headed an expedition to South America in 1735, described an extremely tough metal which he called "platina del pinto," platina being the diminutive of plata, Spanish for silver, and Pinto the name of the South American in whose gold-bearing sands it was found. Quantities were brought to France and England and experiments were begun with the metal which was destined to take its place in the forefront of scientific and industrial progress.

Up to this time the value of platinum was certainly not well recognized. It was frequently used as base metal, just as a counterfeiter today would use lead. In 1774, for instance, some Hollanders who had been deceived on the South American coast by counterfeit gold ingots, made of gold-plated platinum, on making a second visit to the place where the deceit had been practiced, seized upon the guilty Spaniards and hung them to the yardarms of the Dutch vessels.

Platinum is nearly always found in the native state, usually as small glistening granules of a steel-gray color which contain, along with some gold, chrome-iron and sand, an admixture in varying proportions of several other metals—iridium, rhodium, palladium, osmium, and ruthenium, which chemists class as the platinum group. Sometimes it is found in rounded nuggets ranging in weight from a fraction of an ounce to as high as 25 pounds. You could carry away a 25-pound lump of platinum without much trouble, couldn't you? It would be worth today over $30,000.

Seekers after this elusive metal look for it principally in the alluvial deposits of the river systems of the Toura, the Kossja, the Iss and other streams in the Ural Mountains of Russia, at El Choco on the River San Juan, in the gold-washings of the Pinto River, Colombia, and at Minas Geraes, Brazil. Some of it has also been found in Borneo, as well as in Mexico, San Domingo, Porto Rico, Honduras, Ecuador and Australia, and lesser quantities in Oregon, California and Nevada. But when all is said and done, Russia and Colombia are the only countries which have produced any considerable amounts of platinum. About 90 per cent of the world's supply was mined in the land of the former Czars, and until a few years ago even the South American Republic lagged 'way behind. For generations past platinum and Russia have always been spoken of in the same breath, and anarchy and misrule can never take from her the conspicuous place she attained as a platinum producer. Behind the Soviet line today are deposits which would make the hidden treasures of Monte Cristo look like the savings from a penny bank. An exciting story is told

of the explorations for platinum in the gravel deposits at Nicola Pavda in the Ural Mountains. Shafts were put down and some rich accumulations of platinum were encountered.

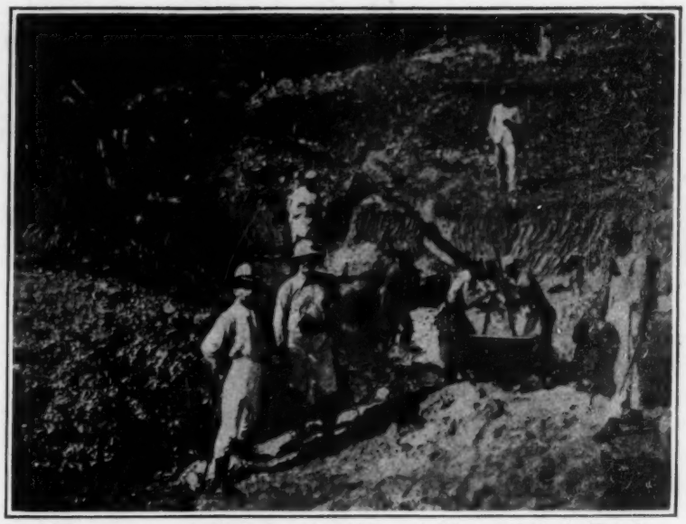
Soon the peasants learned of the quest and scores of them started work as "hishniki," that is, without any right to work there. They would be let down at night with food for several days and with small sluices under their arms with which to do the washing in the deep pits. They dug and sluiced while their friends went for more food. Police were sent to disperse them, but the lure was too strong and they too joined the rascally band. More police were hurried to the scene, but these likewise were tempted by the getting of as much spoil in a day as they would in perhaps a year of honest labor. A veritable riot it was, and the pillage was not stopped until the richest parts of the gravels had been worked out. A drainage tunnel just above the bedrock kept the workings moderately dry, and it is probable that the marauders would have carried off every ounce of platinum had not dredging commenced in the neighboring streams. This caused the flooding of the shafts, and the spoilers scrambled to the surface like rats deserting a burning bark.

"Samorodki" the Russian calls the platinum nugget, the largest one of which ever found weighed something over 25 pounds. This unmatched chunk of metal was discovered more than a century ago in the Urals and was on exhibition during all the subsequent years in the Demidov Museum at St. Petersburg as the rarest natural curiosity of its kind. It is probable, however, that the enterprising Russians sold it at some fabulous price and made a counterfeit for the public gaze. Another large nugget came into the possession of a refiner at Hanau, Germany, only a few years ago. This weighed about 17 pounds, and along with it were two others of 10 pounds apiece. Their aggregate value just before the war was about $17,000, but they would bring at least $45,000 today.

A century ago the Russian gold miners knew nothing of the discovery of the new metal in South America, or of the studies of European scientists. When by chance platinum was recovered as a companion of gold in the Verch-Issetsk district in 1819, they made unsuccessful efforts to learn what manner of metal it was and what purpose it would serve. Even the government laboratory at Ekaterinburg was puzzled. Lubarsky, a mining engineer, was the first to designate it and several years later the famed Alexander von Humboldt, who had previously visited the platinum areas of South America, confirmed the identification. News of the startling discovery spread rapidly among the Ural gold miners, who set out for better fields. Up and down the river systems they traveled and found it here, there and everywhere. But, strange to relate, there was no rush for mining as there was, for instance, to the gold fields of California in '49. This was obviously due to an indifferent government or to skepticism on the part of private land owners. Some slight impetus was given the industry by a Russian platinum coinage, but as soon as this ceased, a further reaction set in. At this time Alexander II. caused an economic upheaval by abolishing serfdom. Russian industry generally was stunned so that for the next ten years the great empire produced comparatively little platinum.

So the metal on which the other countries set a king's ransom became the wastage of the Russian peasant. Off into the wilderness he went for woodcock or partridge, and panning the streams of the Urals, he loaded his gun with the priceless grains. And the birds he brought in were bartered for 10 cents a pair. The price of platinum at this time, as compared with over $100 an ounce today, was about $1.50 an ounce and never exceeded $2. Nor has there been much improvement in mining methods, which were little short of primitive. Even now crude machines are the principal tools in the washing of gold and platinum in Russia. It was not until 1900 that the more prominent platinum operators introduced the dredging machine to the industry, but since that time its evolution has kept pace with the changes in other countries.

From the bitter cold of Sibera's northern margin to Colombia's tropical sun is a far cry, but such is the trail of platinum. Today the world depends upon the South American republic for its principal supply. At first the natives cursed the heavy grains because they interfered with the gold washings and were sometimes so intimately blended with the gold as to make it difficult to recover. It is said that more than $600,000,000 of gold has been taken from the rivers of Colombia since the Spaniards arrived, and all the platinum recovered with it was thrown back until within the last hundred years. Undreamed of fortunes still lie at the bottom of these shallow streams. Much waste resulted, too, from the separation of the platinum from the gold by the so-called dry or "blowing" system, by which the now treasured metal was either recklessly tossed into the street or blown through cracks in the native buildings. Then one day, when the price of platinum was rising by leaps and bounds, the denizens of the town of Quidbo remembered their extravagance and frantically set about to regain the precious stuff they had cast to the four winds. Even the government took a hand and panned the streets while the natives mined their yards. One man burned his house down and was rewarded by finding enough platinum not only to pay for its rebuilding but to give him a balance of some four thousand dollars in cash.



Washing out alluvial platinum and gold by primitive methods in Ecuador

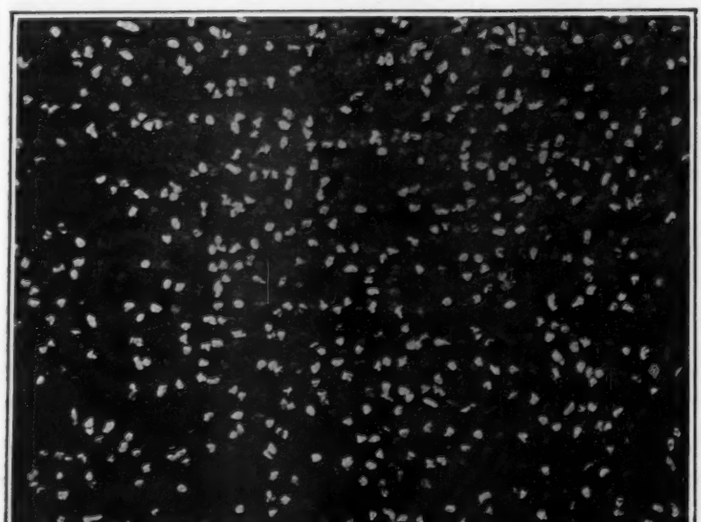
British and American interests are now developing the platinum placers of Colombia with the effectiveness made possible by combined capital and skill, and have several huge dredges at work along the San Juan and Condoto rivers. They have under development 50 miles of river beds and 10,000 acres of banks, and have the dredging rights for the entire length of the San Juan, which is more than 200 miles from ocean to headwaters. Under the laws of Colombia natives may take any mineral they find in the rivers, and it goes without saying that the topmost prices of platinum have incited them to feverish activity. The Choco natives still use primitive methods for obtaining the metal, and in this case woman does most of the work. Dusky maidens dive into the water at depth of from six to twelve feet, scooping the gravels from the bottom, while the men sit smoking cigarettes on the river banks and wash the gravel as the women bring it up. Quite a bit of platinum is secured in this manner but such competition gives little concern to the companies operating the dredge, particularly as the greatest values lie against bedrock from 10 to 30 feet below the bottom of the river and far beyond reach of the native miners.

If this coin, the two sides of which are here shown, had been of genuine gold, its value would have been about $8.00. It was made of $1.75 worth of platinum, which gave it the desired heaviness, and plated with gold to simulate the genuine coin. Today the platinum in this coin would be worth $40.00. The coin has been defaced purposely to prevent its being used as legal Spanish tender

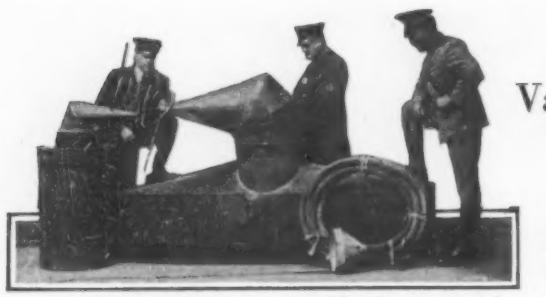
Counterfeit gold plated platinum Spanish coin of the 19th century

It is said that there are not more than 500,000 pounds of refined platinum in all the world and that about one-fifth of this amount is in the United States. This country alone demands fully 160,000 ounces a year. Jewelers grab all they can lay hands on, for platinum amazingly improves the appearance of diamonds by imparting a bluish-white luster to the stones.

Platinum wire, known to the trade as Wollaston wire, is drawn out to invisibility and laid in minute squares across the lenses of great telescopes. Under high magnifying power it becomes visible and enables the scientist to make extremely delicate measurements. Wollaston wire is made by drawing the platinum out as fine as possible, coating it with silver, drawing it again and dissolving the silver recoating, redrawing and repeating the process again and again. Dentists also make extensive use of platinum for rivets, plates, etc., for the magic metal will not oxidize or tarnish and will endure far beyond the human span of life. Great use is also made of it in electrical work, in the manufacture of laboratory heaters and furnaces, ignition fuses, etc., in the dyestuffs and chemical industries, in the making of stylographic pens, watch springs, hypodermic needles, and a hundred other things of which the reader does not dream. During the world war its more spectacular use was for the detonation of millions of explosive shells. Platinum in the form of plates as thin as .0005 of an inch, were used as artificial roofs for the mouths of soldiers whose faces had been shot away, while many a lad had a shattered joint braced by the skillful use of the precious stuff. In a number of instances reported, platinum was employed to replace large sections of skulls, and one famous ace, it is known, has a platinum frontal bone and 16 other bone replacements in his body. The metal is insoluble in any of the acids of the body—in any acid known, indeed, except *aqua regia*—and wounds heal over it.



Grains of crude platinum as washed from placer alluvial gravels, shown natural size



Large still of odd design, captured by the ever-watchful law-enforcement agents of the Government

Alcohol and the Bootlegger

Various Kinds of Alcohol and How Grain Alcohol Is Denatured to Foil the Would-Be Law-Breaker

By Ismar Ginsberg, B.Sc., Chem. Eng.

THE ALCOHOL in drink is not the only alcohol that is known, and neither does the importance of alcohol lie in the fact that it is found in intoxicating liquors and drinks. For the word alcohol is not a specific term at all. It is a generic expression and refers to an entire class of chemical substances which possess certain characteristic chemical properties, and these properties enable their grouping into one category. It is this common and inaccurate use of the word that has given rise to the belief that anything that was called alcohol was the alcohol produced by the fermentation of sugar and therefore fit for human consumption, at least possessing toxic properties which did not affect the human system so quickly and with such disastrous effects, but just so surely in the long run, as the other members of the alcohol family.

As long as prohibition was not in force, there was comparatively little danger of careless people obtaining rapidly poisonous alcohol in the place of the slowly poisonous variety, commonly known as grain alcohol or merely alcohol. But since the prohibition law has been in effect—since a great commerce in intoxicating liquors has arisen through the efforts of the bootleggers—each and every individual that imbibes such liquors is open to very grave danger of poisoning, blindness and death. It is, accordingly, of essential importance that everybody should know exactly what alcohol is, why the term used in reference to only the one alcohol that is the least poisonous of the lot, is not properly applied to all alcohols, and finally what pitfalls and dangers exist in drinking liquors sold by bootleggers. It is also essential to know that alcohol has many other uses of far-reaching importance in human economy than the mere means of getting people hilarious and intoxicated.

It is not necessary for our present purposes to enter into any complicated chemical discussion of what alcohols are. Suffice it to say that the term alcohol covers a large class of substances, all of which, while possessing certain characteristics and properties in common, are nevertheless distinctly individual and possessed of certain other qualities which distinguish them from the other members of the class. There is quite a difference between methyl or wood alcohol, the first member of the class of alcohols, and ethyl or grain alcohol, the second member of the class. Similarly, propyl alcohol is an entirely different substance than amyl alcohol or fusel oil. While most of the alcohols are liquids, nevertheless the higher members of the class are solid, as for example cetyl alcohol, which is a waxy substance, obtained by chemical treatment of spermaceti, the substance found in the head of the sperm whale or floating on the ocean itself and utilized in the manufacture of candles, soaps, etc.

While all these substances—there are many others which belong to this class—are called alcohols, nevertheless only a comparatively few of them are of any commercial importance and probably not more than two or three are familiar to the average person. Perhaps, the most common are the first two members of the group, methyl and ethyl alcohol, while amyl alcohol or fusel oil, and glycyl alcohol or glycerine, may also be considered in this category. Most of these alcohols are known by distinctive names, such as fusel oil and glycerine, and cannot be confused with grain alcohol, which has been commonly known as alcohol without any qualifying adjective. But, the practice of calling this product alcohol and the common use of wood alcohol for making products, such as varnishes and others generally used in the industries and in the household as well, have led to the belief that both substances were similar in properties, and that if the one could be consumed as an ingredient of various intoxicating liquors, the other could be utilized as well for human consumption without any worse effects than those experienced in drinking alcoholic liquors.

But, wood alcohol or methyl alcohol—or as it has been recommended that the name be changed, methanol—while not differing very greatly from grain or ethyl alcohol, the alcohol produced by sugar fermentation, is a very different substance as far as its physiological action on the human system is concerned. There are other examples of substances which, while closely allied chemically, are markedly different in the changes that they bring about in the human system. This is perhaps best exemplified in the case of the two mercurials, corrosive sublimate and calomel. They are both chlorides of mercury, containing the element mercury and the element chlorine in chemical combination. The corrosive sublimate contains two units or atoms of chlorine to one atom of mercury, and is consequently known as bichloride of mercury. The calomel, on the other hand, contains one atom of chlorine to one atom of mercury. The difference of a single atom of chlorine distinguishes between the deadly poison and highly effective antiseptic, and the common cathartic of relatively far lower poisonous properties.

The difference between wood alcohol and grain alcohol is no less striking than that between corrosive sublimate and calomel. No one would think of taking bichloride of mercury unless he were of a suicidal bent, but many do not hesitate to drink wood alcohol in place of grain alcohol, not knowing that they are imbibing a deadly poison, just as poisonous if not more so, than bichloride. Wood alcohol produces blindness and death. It is not alcohol as the word is commonly known, but a vile, virulent poison to be shunned as we shun carbolic acid or arsenic or any of the other commonly known poisons. Furthermore, it must be remembered that drinks made from wood alcohol, even though they contain only a relatively small percentage of the same, must become deadly poison of the worst sort.

However, this form of alcohol although a deadly poison, is of real commercial importance, and it must not be condemned because it is ignorantly used for human consumption. For certain purposes wood alcohol is essential. It forms an important industrial chemical. It is made from wood, more specifically hard wood, which is distilled in retorts in the absence of air. Wood alcohol is used in making paints and varnishes. It is a clear, colorless liquid, just like grain alcohol, and it possesses an alcoholic odor, which is, however, quite different from that of grain alcohol, but the odor is not always readily distinguishable from the latter by those inexperienced in handling the substance. Wood alcohol is also used as a denaturant of grain alcohol, whereby the latter is rendered unfit for human consumption. Formaldehyde, the common disinfectant, is made from wood alcohol. The latter is used in manufacturing synthetic dyestuffs, in purifying petroleum and in various other important chemical and allied chemical manufacturing processes. Wood alcohol burns with a comparatively high heat. It is used as a fuel for both heating and lighting purposes. Miners' lamps are lighted with its aid. This alcohol also finds use as a paint remover, and is utilized in making transparent and disinfectant soaps. It may be mixed with the water in the automobile radiator, acting as an anti-freeze agent. Clothes can be dry-cleaned with wood alcohol.

Tanks which can be concealed under the bootlegger's coat

The manufacturer of grain alcohol, on the other hand, has always been under governmental control. Intoxicating drinks were formerly highly taxed, and before the days of prohibition brought in an important part of both Federal and State revenue. While wood alcohol can be used for many purposes for which grain alcohol is also well suited, nevertheless each alcohol has its own distinctive uses in which it cannot be supplanted by the other. Industry requires both alcohols, but it cannot afford to pay the tax on grain alcohol. So, a method was arrived at which made it possible for grain alcohol to be used by the industries and still not be subjected to the high tax. This was accomplished by denaturing the alcohol; that is to say, by the addition of various substances, formerly consisting of wood alcohol and benzol for the most part. Benzol, incidentally, is a product derived from the distillation of coal tar and scrubbed from the gas made from coal. The substances referred to rendered the grain alcohol unfit for human consumption. In that condition the alcohol did not have to pay a tax and could be used for many purposes to good advantage, in the place of the much more expensive pure grain alcohol.

The uses for grain alcohol and denatured alcohol are very numerous. Before the days of prohibition the pure grain alcohol was used for making many pharmaceutical, cosmetic, perfumed, dentrifical and other similar preparations. At the present time, however, pure alcohol cannot be had except for special medical and scientific purposes. There has been developed a host of specially denatured alcohols, which are made up according to governmental formulæ. The ingredients that are added, while they all render the alcohol unfit for human consumption, are very carefully selected so that they do not impair the particular product that is to be made with the alcohol. Thus, for example, the denatured alcohol that is used in the manufacture of cigarettes, cigars, smoking and chewing tobacco, is mixed with a little nicotine and a yellow and blue dye. These products do not injure the tobacco, but they make the alcohol unfit for drinking purposes.

There are at the present time more than forty-five of these special formulæ for denaturing alcohol, covering every branch of industry in which grain alcohol is used. Each formula is designated for specific purposes; and the manufacturer, demanding a certain denatured alcohol, must show conclusive proof that his manufacturing process demands the particular

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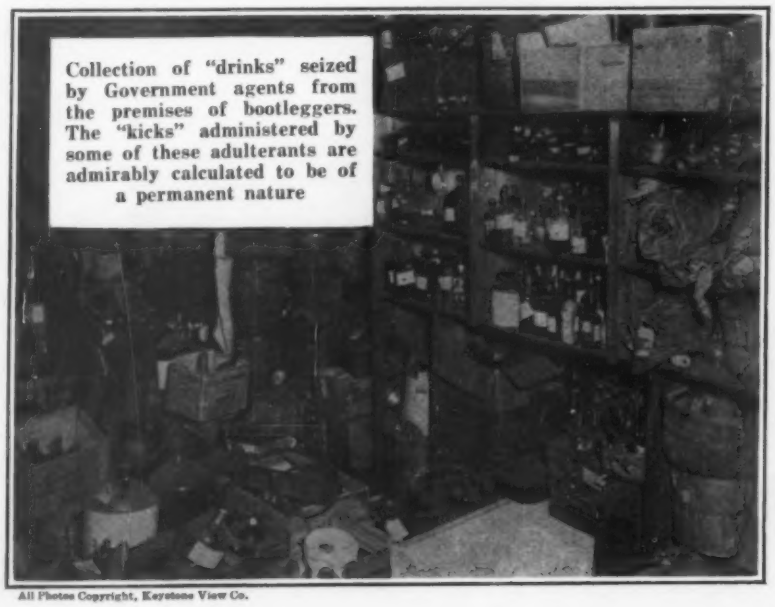

Collection of "drinks" seized by Government agents from the premises of bootleggers. The "kicks" administered by some of these adulterants are admirably calculated to be of a permanent nature

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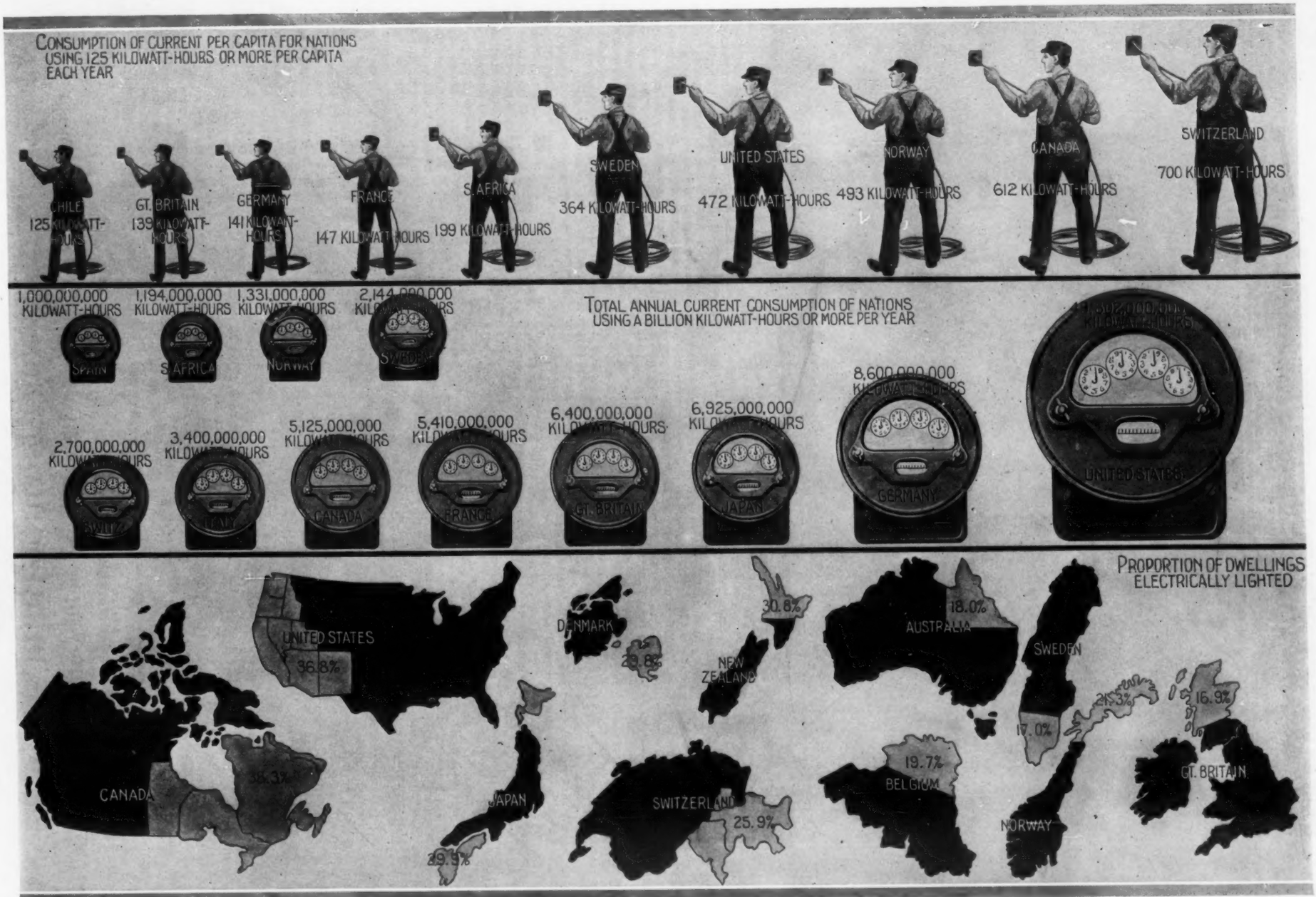


Drawn by our Staff artist, George Wall. Copyright, Scientific American Pub. Co.

ELECTRICAL STATISTICS AT A GLANCE

HEREWITH we present a graphic statement of the electrical-energy consumption of the leading nations. In the upper panel appears the consumption of current per capita for all nations in which this figure exceeds 125 kilowatt-hours. It will be seen that two small nations and one large one use current more liberally than we do in the United States; and it will be observed that all three of them are countries in which hydro power is abundant. Niagara's power alone, divided on a basis of approximate equality between Canada's nine millions and our 110 millions, would make a huge difference in per capita consumption of the electric current between ourselves and our northern neighbor.

In the second panel the larger nations necessarily come first, since here the basis of comparison is the total and not the per capita consumption of current. All nations are pictured here whose annual current requirements exceed a billion kilowatt-hours; and it will be noted that several countries appear here that are not among the leaders in per capita consumption of electricity, and *vice versa*.

The third panel shows, for each country represented, the percentage of the population that lives in electrically-lighted homes. This, in these days of apartment houses, it will be observed, is not quite the same as the percentage of electrically-lighted homes itself would be. The drawing covers all countries in which the percentage in question is greater than 15. The graphic comparison here is, properly, on the basis of area; the several maps being divided between light and dark in the same proportion as the dwellers are divided between electric lights and other sources of illumination. There is no connection at all between the scales of the different countries. Since the interest lies in the relation between light and dark on each map separately, and not in the relation between any two maps, the fact that Switzerland is not as large as Australia has no bearing upon the accuracy of our graphs: our artist has merely made each country large enough to fill the reader's eye.

Tearing Down to Build Again

How the House-Wrecker Squeezes the Last Dollar of Value Out of the Buildings That He Handles

By A. G. Ingalls

THE LAW of treasure trove grants the possession of rediscovered valuables to the original owner if he can legally establish ownership. But the contract between the housewrecker and the owner of a building he is to tear down usually stipulates that when the building has been duly vacated and turned over to the wrecker, all of its contents belong to him regardless of what may be found secreted in the walls or under the floors when it is torn down.

Therefore, when the foreman of a certain small job not connected with housewrecking sent his only assistant to the junkyard kept by a housewrecker to purchase a length of old iron pipe to be used as a roller; and when the latter, noting a cap on the end of the pipe he had selected, removed it and brought to light a $4500 cache of ringing gold eagles—there was a lively contest for the possession of the coin. The foreman, thinking to quiet his helper, split with him on the not very generous basis of $500 and $4000, keeping for himself the fat end of the pool. But the helper, having himself been the chooser of the lucky piece of pipe from a veritable mountain of junk iron, regarded himself as entitled to a half share in the find; or if the division were to be unequal he claimed with justice the larger part of the treasure. He refused to hush, therefore, and disclosed to the original owner that a piece of paper, brown and crumbling with age and bearing his deceased parent's signature, had been wrapped around the coins in the pipe. This the foreman had destroyed at once. On such evidence, however, otherwise unsupported, the heir of the original owner was unwilling to proceed legally for the possession of the money. Indeed, had he won, the prize would have reverted to the housewrecker, the pipe having come to the wrecker's salesyard with a quantity of junk from an old house he had demolished. Of all this the housewreckers were never advised and the money remained in the hands of the workmen.

Rarely, however, do articles of value disclosed by his operations get away from the housewrecker. In the discovery of the unexpected his calling is speculative, and it is the thrill of the finding of unanticipated treasure that holds him to his calling—the possibility of unearthing from the walls of some old landmark secreted articles which, if not always in the class of treasure trove, are often replete with historical romance. This is especially true of the older parts of New York City with its ancient houses dating back towards the days of the Dutch occupation of Manhattan.

When the old residence of Alexander Hamilton was torn down by the housewreckers to make room for a modern structure, one of the fireplaces of the historic home was secured by the Alexander Hamilton Institute of New York City and removed to its social hall. A plan of the fireplace was carefully made, the bricks were all numbered, the fireplace torn down and then rebuilt in the new location exactly as it had been in the old

Rare old fireplace rescued from the housewrecker

Our larger cities are always in a physical state of violent flux. Their growth is so rapid and the evolution of new business centers from old residential sections is so frequent that a highly specialized industry known as housewrecking has grown up. To save time and trouble the building to be demolished is turned over in its entirety to the wrecker whose bid, based on the resale value of its salvaged parts, is the highest. A contract is entered into, providing, often with a bond, that the site occupied by the outworn or unsuitable structure is to be stripped to the bare ground before a certain date. Accordingly, the wrecker sets to work, with his crew of skilled barmen and rough workers, to erase all trace of the old building, taking his profit in the form of a speculation on the resale value of the stone, brick, lumber, glass and junk in general that it contains. Sometimes he loses money, but generally he wins, for he has grown up in the business and knows from experience just what unobvious pitfalls to avoid. Many houses of early date fall to his wrecking bar, but the vicissitudes of the development of such a great city as New York, for instance, call also for the reduction in many cases of buildings that are comparatively new.

For instance, a massive granite building was removed by the wreckers of that city from the busy corner of Fifth Avenue at 42d Street, to make way for a more modern structure of steel. Yet so rapid was the shift of the business center toward that part of the metropolis that this, in turn, after only seven years, was torn down by the wreckers to make way for a real skyscraper.

For similar motives the famous Dr. Parkhurst's Church, though quite new, having been built in the nineties, was supplanted by an office building. In this case the wreckers who purchased the church were able to make good handsomely. Most of the façade of the church, including a group of 30-ton granite columns, the pediment and a large amount of terra cotta, was shipped to Hartford, Conn., where it now graces the front of a newspaper office. The façade of the old Assay Office, after passing through the hands of the wreckers, became an addition to the Metropolitan Museum of Art, while the wreckers were able, by carefully burning the flooring over which so much valuable metal had passed, to recover about $3000 in silver which had become ingrained in the wood.

Sometimes the bidder for the privilege of tearing down old structures underestimates the cost of the work and loses heavily. Such was the case when the old Grand Central Station in New York was to be replaced by the present one. On getting into the job the wrecker discovered that the old pile was a veritable fortress. The execution of the contract ruined him. Such work involves a close estimate of costs balanced against problematical returns from the sale of the contents. In the case of brick, which is very often the largest commodity to be taken into consideration, the buyer may win or lose according to whether the mortar between the bricks may be knocked off easily or

Courtesy Albert Volk & Co.

Of all the materials salvaged from the operations of the housewrecker, brick probably brings the best return. Second-hand brick, even if somewhat imperfect, may be used for the inner course of a wall, where they are as good as new brick. In many cases they are suitable for the entire wall. But if the mortar clings obstinately to the brick the cost of cleaning makes them a liability rather than an asset to the housewrecker

Acres of used bricks stored during a period of low prices. The pile shown is uniformly four feet deep

whether it clings so closely that the labor of cleaning is too costly.

If the wrecker can make an immediate resale of part of the materials direct from the demolition job, and thus save rehandling and interest losses, it is to his advantage to do so. In other cases he must store them, and for this purpose a yard is a necessity. This is always some open lot in a backwater of the city where land values are not high. Here, too, he is generally near a section of slums whose occupants come to buy in lots running from fifty cents to hundreds of dollars. "Everything from a needle to an anchor" is the motto at the housewrecker's yard; for when a house or other building is torn down "everything but the squeal" is salvaged and sold.

Many are the peculiar articles uncovered by the work of the wrecker. In one case a box containing about 25 pounds of counterfeit dimes and quarters was found. The bogus coins were such crude imitations of the real that the crook had been unable to dispose of them to advantage and had hidden them in the walls of a New York house. In another case several gem stones recovered from behind a wainscoting in a Maiden Lane jeweler's turned out, to the keen regret of the wrecker, to be common quartz crystal. In wrecking one of the New York homes of ex-President Cleveland a small, half-concealed cupboard was found to contain a rare set of Delft china. The barman who discovered it attempted to carry the set home but was noticed by the foreman, and it reverted to the wrecking company. In Hanover Square, New York, an old underground reservoir was found to contain a full demijohn of gin. However, the boss of the job was suspicious of the condition of the liquor, and since in these pre-prohibition days gin was not the rare commodity it now is, it was smashed with a brick. But in Gansevoort Street the workmen were able to beat the foreman at that game. The latter was first made aware that something was wrong when he noted many of his men were tipsy. Investigation revealed that deep down in the cellar of the building being salvaged, which was a storage warehouse that had collapsed from overloading, there was a small pool of wine from several barrels of that liquid which had been smashed by the fall of the structure. The workmen had been lying flat on the debris lapping up the alcoholic beverage. It became necessary to place a guard over the spot before the force should be wholly demoralized.

The actual work of tearing down buildings is done by gangs or crews made up of two kinds of workmen. Of these, the barmen are old hands, especially trained to the work which involves the use in many cases of skilled judgment. The remainder of the workmen are rough labor, largely foreign, whose chief qualification is a strong back and the ability to lift and carry. The barmen are highly unionized. Their work is somewhat seasonal, owing to the fact that so many leases expire on May 1, when wrecking operations can most conveniently follow. Many of them spend the winters working in the woods at lumber camps.

The housewrecker divides all recoverable materials into six groups. These are brick, stone, lumber, glass, junk and dirt. In this case, "dirt" covers anything that has no resale value, although it usually consists of mortar cleaned from bricks and plaster. As dirt is a liability, when a wrecker bids on a job, he always has an eye to the amount of it that will have to be carted away. In New York most of the dirt was, until recently, dumped into the ocean by means of barges. Much of it now goes to fill low tracts in the suburbs. The motor truck can take a load of three or four cubic yards to such a place for about a dollar a yard, the dumping privilege costing 60 cents per yard in addition.

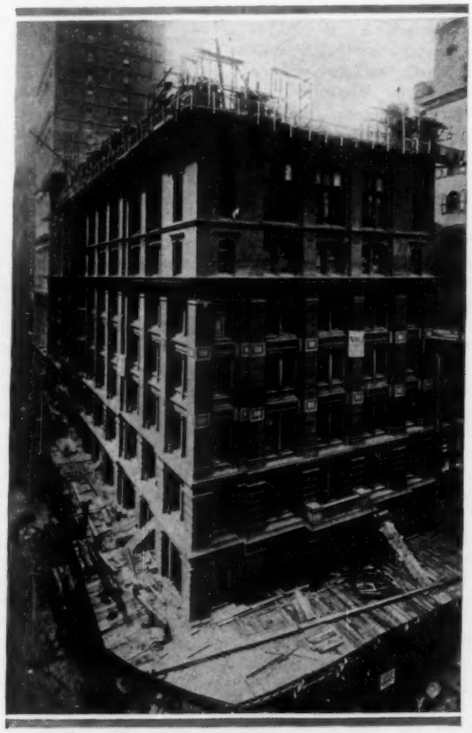
Stone includes granite, brownstone and limestone. This has little or no value for rebuilding except in foundations. Especially is this the case of brownstone. During the '70s and '80s the brownstone front was regarded as the finest thing available, and the brownstone house came to be an indication of wealth. This stone came largely from the valley of the Connecticut River. Unfortunately, the practice was to lay it up into a housewall with the natural stratification in a vertical plane, a result of the fact that it could be trimmed in that manner with less labor. This facilitates the entrance of water which expands as it freezes, prying off the face of the block. Such stone, when removed from wrecked houses, cannot be used for anything but foundations. However, all kinds of stone can be used for this purpose and much of it has such a low value that it is often given to whoever will agree to "ride" it away from the job. Flagstone, on the other hand, has a fine market and can be readily sold over the telephone. The recent demand for Venetian gardens with walks of irregularly broken stone through which grass and accidental flowers are permitted to grow, accounts for this fact. The flagstones are thrown from the truck on to a hard surface, resulting in a natural fragmentation which prepares them for the purpose.

Concrete is a difficult thing to destroy in case it has been reinforced with iron bars. As time goes on and concrete is used more and more there will be increased trouble in wrecking it. In some cases dynamite has been used to break it up, but this cannot be done cheaply enough in a crowded city where many safeguards are necessary.

Demolition of an old building. The bricks and debris slide down through a temporary chute to the waiting trucks or dump wagons and are removed

Many fine old mantels have been salvaged from houses in the older part of New York. Some of these early homes of the wealthy of a century ago remain untouched in parts of the city now given over to tenement houses. In one case the wrecker had occasion to patch a rare but damaged mantelpiece before selling it. Several years later he again found it in his own hands, the house into which it had been placed having changed hands and been done over. Thus he had made two separate profits on the same article. In another case, that of a very old wrecking company, articles bearing its distinctive mark came back to its yard after 30 years.

In Boston, after the wreckers had removed an old building and exposed a 45-foot cellar, a well, filled with debris, was discovered in the bottom. When this was cleared out it was found to have been lined with old oak planks bearing the adz marks of the hewers. As they had always been below the water level they had not rotted but turned a beautiful blue. This rare wood was worked up into a remarkably beautiful table for a well-known club.



The sidewalk beneath the work must be protected from falling bricks during the wrecking process

In one house which is now being torn down in the most aristocratic section of New York a sealed tin box was found in a cache in the walls of the cellar. When the box, which had been carefully soldered up, was opened it was found to contain a wedding cake. Except that its center had sunk it remained in good condition and samples were eaten, although not with relish, by the gang of wreckers. From another wrecked house in this neighborhood the entire interior finish of a drawing room was purchased of the wreckers and set up in another part of the city where it graces the interior of a manicure parlor. Many parts of these fine old homes are sold to motion-picture houses as properties or stage settings. In this way the interiors of the Mortimer Schiff residence in New York became the property of a motion picture producer.

Brick probably nets the best return of all materials salvaged by the wrecker. This is, of course, owing to the fact that there is usually so much of it. Ordinary brick is cleaned of old mortar and readily commands a price of $10 to $15 a thousand bricks. In many cases it is used for the outside walls of new structures, and if in very bad condition it may still be used to good advantage in the inner course of a wall. In fact, in many cases old brick have higher intrinsic value than new ones, having been burned at a time when coal was less expensive, hence with less tendency to underburn the brick. But the little Dutch bricks and the pale bricks cannot be given away. They class as "dirt." Brick that has been laid with cement instead of mortar is a bad buy for the wrecker, and he is careful to allow for it wherever he can learn that it has been used. Such brick is not worth the cleaning, as, owing to the strength and clinging qualities of the cement, it comes out of a demolished wall in large blocks. During a period of financial depression the market for brick may be so poor that it is worth while to store them until the price is higher. This can be done quite cheaply as they may be kept out of doors.

Lumber is often one of the most valuable assets of an old building. Especially is this true when some ancient structure is torn down. Here the timbers are pretty sure to be of pine, a kind of lumber which now sells new at around $110 per thousand feet and may be sold by the wrecker at, perhaps, $35. These old pine beams are sometimes bought up by architects for beamed ceilings, especially if they happen to bear the adz marks of the original hewer. Their tone of age can be perfectly duplicated only by aging, while their freedom from warping tendencies after being placed renders them far superior to the kiln dried lumber so much used today. Such timbers are sometimes buzzed up into smaller sizes in the yard of the wrecker, who keeps a buzz saw for this purpose.

In addition to the old beams removed from the houses of a former aristocracy, many of which have been reduced to the status of little restaurants or Chinese laundries, the wrecker finds recovery values in boards, joist, studs, sills, plates, doors, furring strips, and lath. Old lath are bundled up and used by shippers as filling strips in box shipments of all sorts. Doors of all kinds, many of which may with proper treatment be remade into beautiful colonial doors, are to be dug up in the yards of the wrecker.

In the case of the birthplace of Theodore Roosevelt, the wreckers did not foresee the future. When a movement to restore this historic birthplace, which had already fallen to the bar of the wreckers, was begun the original wrecker was consulted regarding many details of the vanished house. He was able to say that the front door had reposed in his sales yard during a long period of time. Yet when sought it could not be found. It had probably been sold off to someone who is today ig-

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Our Point of View

The Architecture of Engineering

REPLYING, in the course of a lecture on the Forth Bridge, to the charge that his great masterpiece was lacking in beauty of outline, Sir Benjamin Baker replied that the question of an object's purpose and use must enter into any judgment of its artistic merits. "A Corinthian column," said he, "standing in the portico of a classic temple, is recognized at once as being useful and artistically beautiful; whereas if two pipes, shaped as Corinthian columns, were placed on the deck of an Atlantic liner to act as smokestacks, they would excite universal derision."

On the other hand, we cannot shut our eyes to the fact that too many engineering structures have been built, and are today being built, purely on lines of utility and without the slightest thought as to whether the finished structure will be inherently ugly or beautiful. If, as some would have us believe, the shades of the departed visit this earth and take a lively interest in its development, what would be the comment of Leonardo da Vinci upon some of the structures of this age of steel. "Great engineering," it would mutter, "but wretched artistry." Yet, there is good promise for the future, since the engineer and the architect are beginning to realize the bond which exists or should exist between them. The architect, however, should be careful never to interfere with forms which are determined by strict engineering considerations. In other words, he should never distort the general outlines as called for by the stress diagram. In a recent illustration in an architectural journal, the architect, in an endeavor to give a more graceful appearance to an arch bridge, has swung the columns of the spandrel sub-arches out of the perpendicular, and converged them to meet on the top of the main piers. Pretty? Graceful? Artistic? Well, possibly; but considered from the engineering standpoint, the result is positively excruciating.

Bogey of Aerial Bombardment

SO DISTURBING are the effects of gross exaggeration on the part of certain naval and military writers, that we feel constrained to offer a protest on behalf of a long-suffering public. It is, of course, the duty of these experts to keep the public alive to the necessity of adequate naval and military preparedness, and the SCIENTIFIC AMERICAN endeavors to do its share of this work; but unfortunately the majority of those who rush into print on this subject are given to gross exaggeration. Nowhere has this been so noticeable as in connection with the discussion of aeronautics as applied to war. These gentlemen are persistently dinning it in our ears that "in the next war" we shall witness the instantaneous wiping out of whole cities by the dropping of bombs filled with high explosives and death-dealing gases. These direful prognostications are based upon what Germany did during the war. The argument runs in this fashion; whole fleets of German airplanes and airships passed at will over the city of London, dropped their bombs, and did enormous damage. Improvements in aircraft and bomb-dropping are such that future attacks will be tenfold or one hundredfold more deadly. Such attacks will come without warning and the whole nation may be paralyzed, for military purposes, after a few hours of the first attack.

Now these predictions tend to exaggerate what happened. The German attacks were made upon a people who were quite unprepared to meet them, and who had to improvise and develop air and land defenses while the destruction was going on. Furthermore, these scare-mongering scribes fail to mention that the conditions of aerial warfare being known, the nation attacked will be prepared to meet the enemy in the air, and either defeat him or so greatly cripple him as to render the attack largely abortive.

For many years Hudson Maxim, who surely should know something about the effect of high explosives, has repeatedly stated that the effect of an explosive bomb is local and far more limited than is popularly believed, and this we think is proved by the official figures which have recently been published by the London Fire Brigade, dealing with the air raids to which London was subjected during the course of the war. The total number of raids was twenty-five, and they took place between May 15, 1915, and May 20, 1918. Now, although many of these were carried out by whole fleets and sometimes very large fleets of airplanes or Zeppelins, and although no less than 355 incendiary and 567 explosive bombs were dropped upon a densely built and populated city, only 525 deaths were caused, and the total damage to buildings was only $10,000,000. In other words, it took on the average 1.75 bombs to kill one person, and each bomb did material damage to the extent of less than $11,000, or the cost, let us say, of one small suburban cottage.

Now making all allowances for the post-war development of the airship and the bomb, we can see how ridiculously exaggerated is this talk of a capital city being wiped out in a few hours bombardment. Poison gases? Yes, they will be deadly; but equally certain it is that the world's laboratories will have developed neutralizing gases and other protective devices, which will go far to rid the gas bomb of its terror.

The war is over and, unless we are greatly mistaken about the temper of the people, they are asking for a breathing spell, in which they may have a surcease from this everlasting shouting from the house-tops of the terrible things which will happen "when the next war comes."

What the world needs today is a reasonable and alert spirit of preparedness, walking hand in hand with a spirit of human brotherhood, and both moving slowly, it may be, but surely, to that ultimate goal where war shall be no more.

Safety First in the Mines

IN OUR issue of April last, commenting on certain recent mining accidents attended with large loss of life, we called for an organized campaign to secure government action in reducing mining fatalities. In this connection, we now direct attention to the excellent work which has been done and which is still being done by the Bureau of Mines in promoting the safety of the miner. Even if the phrase "safety first" did not originate with the first Director of the Bureau of Mines, it is certain that this bureau was among the earliest supporters of the safety first movement in this country. During the eleven years in which it has been at work, the number of men killed per thousand has decreased from five to three. We are assured by the bureau that the recent great disasters, which attracted so much attention on account of their dramatic features, did not on the average account for more than 10 per cent of the men killed in mining; in 1918, indeed, the larger disasters constituted only two per cent.

Some months ago, the director issued a statement calling attention to the fact that unless unusual care was exercised in resuming operations after the strike, many fatal accidents could be expected. The bureau's analysis of mining accidents has revealed the fact that the great majority of accidents happen under circumstances where the care taken by the individual to avoid injury is the principal factor in the matter. Recent statistics show that approximately one-half of the number killed within a certain period met their deaths from falling roofs and about eight per cent by being struck by cars.

Now, although we are strongly opposed to anything that savors of so-called paternalism, we believe that it is the duty of the Government to secure the safety of human life by wisely directed legislation. The statistics of accidents and the recommendations of the Bureau of Mines, when it is shown to be desirable should bear fruit in legislation of the kind which enforced the use of such life-saving devices as the air-brake and the automatic coupler on our railroads.

How Big is a Ship?

A CURIOUS controversy was started in shipping centers by the announcement of the United States Shipping Board, that the reconditioned "Leviathan" will make her first voyage, after reconditioning, with the distinction of being the largest ship afloat. The spokesman for the Board is careful to make it clear that he makes this claim for the "Leviathan" only in respect of her gross tonnage, giving the "Leviathan's" gross tonnage as 59,956 tons, and the "Majestic's" as 56,551 tons. It is explained that gross tonnage is obtained by measuring the interior of the ship, to ascertain its internal volume, and then dividing the total by one hundred to obtain the tonnage, one hundred cubic feet being figured, according to this system of measuring, as equal to one ton. In reconditioning the ship, certain internal changes were made, with the result that considerable new measurement space was found to be available and the ship as thus measured, was stated to be the larger of the two.

The question of the relative size of two ships turns, like many such questions, upon the system of measurement employed. The SCIENTIFIC AMERICAN has already gone on record as stating that the "Majestic" is the largest ship afloat. In making this statement we followed our invariable rule, estimating the size in terms of the length, breadth and depth. Not long before the war we were shown these two ships by their designer, Dr. Ernest Foerster, who is the designer of their hulls, and he informed us that they were identical ships, except that in order to constitute the "Majestic" (then "Bismark") the largest ship afloat, the company decided to introduce two additional frames amidship. Hence, the difference in length between the two ships, the "Majestic" measuring 956 feet and the "Leviathan" 950 feet. The breadth and depth of the two ships is identical. For the above reasons, we think that, although the contention of the United States Shipping Board that during the internal alterations they have gained interior accommodation space within the similar hull of the "Leviathan," doubtless is correct, it would be wise, in order to avoid confusion in the public mind, to compare the two ships as to the dimensions of their hulls, and regard the "Majestic" as the larger of the two sister vessels.

Fate of the Guns That Bombarded Paris

EVEN at this late day we receive letters from correspondents asking for a description of the 75-mile range guns which bombarded Paris, their number, their construction and their present whereabouts. With regard to the number of these guns and what has become of them, we are able, through the courtesy of the Krupp firm, to give an explicit answer. As regards the construction of the guns, and such matters as the caliber, length, weight and muzzle velocity, we have no particulars which we consider to be absolutely reliable. The Krupp firm has not made these details public, nor have we seen any communication in the military or technical press which claims to be more than approximately correct.

The letter received from the Krupp firm was prompted by the widely circulated statement that, contrary to the assurance given by the Germans, war material was being manufactured at Essen, and that several of the super-range guns used in the bombardment of Paris in 1918 were hidden in the sand dunes off the North Sea. In refutation of this, Krupp assures us that only seven, and not twelve, of these guns, as stated, were ever built; and that in the summer of 1918, at the time when the German Army commenced its retreat, only three of these guns were at the front, the remaining four being at that time in the company's work shops. As there was no longer any question of their use against Paris, two of these four guns were completely dismantled, their component parts being used partly for other guns and partly melted down. The other

Our Point of View

two, they assure us, were shortened in the barrel, so that they no longer existed in the shape of long-range guns, and were finally, in November, 1919, scrapped and melted down in the firm's branch, established at Magdeburg.

We are assured that when the Armistice was concluded only three super-range guns were still in existence and these had been withdrawn at the beginning of the German retreat. The letter goes on to say that, in view of the threatened occupation of the Ruhr district by the allied troops, these last three guns also were completely destroyed at the close of the year 1919, their remains being melted down to use in the manufacture of peace-time material. The letter concludes as follows:

"All reports asserting the existence of super-range guns in Germany are pure invention and are disseminated from certain quarters for the sole purpose of keeping suspicion against Germany alive. This is our chief reason for asking you to be so good as to contradict the statement in question and to give the true facts of the case, a step which, in a publication of so high a standing and so wide a circulation as yours, cannot fail to produce the effect desired."

In the interest of truth and fair play, we are glad to have this opportunity to give some very interesting facts about these famous guns, and also to do justice to the sincerity of the firm in meeting their obligations—the more so, since over three years ago we stated our conviction that Germany was so completely disarmed that the very last thought which she could have in her mind was that of engaging in another war.

In Justice to the Railroads

IT IS becoming evident that the criticism of the management of our railroads, which has been growing in intensity during the post-war period, has a common origin and that it forms an important part of that secret and subtle communistic propaganda which aims at the nationalization of American railways. With that accomplished, the next object would be the nationalization of certain leading industries, with the hope that ultimately all industries would be brought into the fold. Of late years, this attack has been directed principally against the management of our railroads, on the ground that it is generally incompetent and guilty of gross extravagance. The principal weapon employed has been the use of statistics skillfully manipulated, by which it is possible, in dealing with the uninstructed public, to prove almost anything.

One of the latest attacks of this kind was made by Senator Couzens of Michigan, who charges that American railroads have shown no increase in efficiency in the last eighteen years, and that they are now intending to cut down expenses by reducing the wages of the employes. The statistics adduced by the Senator, which, according to the *Railroad Age*, have been widely broadcasted throughout the United States, call for a reply. The challenge has been taken up by one of our ablest railroad men, Julius Kruttschnitt, Chairman of the Executive Committee of the Southern Pacific Company, who states that, out of a reduction of approximately one billion dollars a year in labor cost of railway operations, only 350 million dollars is due to a decrease in wages. The balance of that great saving has been due to efficiency and economy of operation.

In the course of his argument he points out that in 1922 the railroads carried approximately the same amount of traffic as in 1920, and this was done with an average of 1,645,237 employes in 1922, as against 2,012,600 employes in 1920. Answering the Senator's statement that for eighteen years there has been no improvement in locomotive performance, it is shown that the real measure of efficiency is to be found in the fact that the average number of revenue tons per train increased from 310 tons to 652 tons, or 110 per cent; and by means of this increase and efficiency in the handling of trains, the railroads secured an increase of 110 per cent in ton-miles with an increase of only 20 per cent in train-miles. Putting it another way, Mr. Kruttschnitt shows that with only 97 per cent increase in power they moved 139 per cent more revenue ton-miles. Another convincing argument is based on the amount of transportation for every $100 investment in railroad property. Thus, in 1890 for every $100 of investment the railroads carried 983 tons of freight one mile and 153 passengers one mile. In 1920 for every $100 investment they carried 2063 tons of freight one mile and 231 passengers one mile. Speaking of the work done by locomotives Mr. Kruttschnitt shows that in eighteen years, from 1903 to 1920, the average tractive power of locomotives increased from 21,781 pounds to 36,365 pounds—an increase of 67 per cent. The number of revenue ton-miles during the same period increased from 173 billion to 413 billions, or about 139 per cent.

These excellent results have been obtained, it should be remembered, during a period in which it has been very difficult to secure the capital which was so greatly needed to make good the depreciation of the railroads due to government control during the war. Had it not been for these economies, many of our railroad systems would have gone to smash. That is to say, if the statement of Senator Couzens had been true, many of our railroads would have by this time become utterly bankrupt. That they have been successfully carried through the period of storm and stress is at once a flat denial of the Senator's charges and a tribute to the executive ability of American railroad managers.

Shipping Board's Trio of Fast Ships

THE SHIPPING Board's announcement that they intend to recondition the "Agamemnon" and "Mt. Vernon," brings within measurable distance the time when the public will see a first-class Atlantic passenger service flying the American flag. By first-class we mean, of course, ships of large size, of twenty-three knots speed or over, and providing sumptuous accommodations.

The "Leviathan," which is scheduled to make her maiden voyage as an American passenger ship on July 4 next, should be capable of a maximum speed of over 24 knots, and a sustained sea speed of 23.5 knots. The "Agamemnon" and "Mt. Vernon" both made the trans-Atlantic passage, when they were German ships, at a maximum average speed, if we remember rightly, of 23.5 knots. They are old boats it is true, being from eighteen to twenty years of age; but if the Shipping Board should see fit to change them, as they did the "Leviathan," from coal to oil burning, they should be capable of making the trans-Atlantic passage at 23.5 knots today.

In their day these two ships held, together with the "Deutschland," the blue ribbon of the seas, and they held it until the advent of the "Lusitania" and "Mauretania," the ill-fated "Lusitania" having had a record of 25.5 knots and the "Mauretania," the present holder of the record, crossing at an average speed of slightly over 26 knots. The "Agamemnon" and "Mt. Vernon" are sister vessels, with a length of 706 feet and a gross tonnage about 20,000 tons. The construction is excellent and the provisions against disaster by collision and by fire are fully equal to the best that are to be found in ships of the present day. They have double skins throughout the engine rooms and a continuous line of side-bunkers reaching well up to the bow. Also, throughout the passenger decks, a series of steel bulkheads and fire-doors affords a most necessary safeguard against the spread of a fire.

The engines of a total horsepower of over 45,000 are the highwater mark in the development of the reciprocating marine engine. There are four six-cylinder engines, each in a separate compartment, and arranged in tandem, two on each of the twin-screw shafts. When these two vessels, thoroughly reconditioned, re-enter the service, their career will be watched by shipping men with unusual interest.

Seventy-Five Years Ago

READERS of the SCIENTIFIC AMERICAN of April 29, 1848, found on the first page of that issue, an article on the "effects of cannon balls on iron steamers." It was recorded, that because of damage done to the iron steamer "Ruby" by experimental shooting from the "Excellent," it was "expected that the Admiralty will stop the building of iron steamers." The shots we are told, "not only penetrated the side struck, but in some instances passed through the other side carrying with it whole plates of iron."

We note that, seventy-five years ago, the SCIENTIFIC AMERICAN was giving warning against the follies of perpetual motion. Thus we read that "not a week passes over our heads but we see or hear of some lucky person who has discovered perpetual motion. The pursuit of this motion is not confined merely to the illiterate and to unlearned mechanics, but men of rare intelligence, wealth and learning have pursued the phantom." The editor suggested, that a diffusion of knowledge of the principles of mechanics would soon dispel this chimera.

In the issue of May 27, 1848, mention is made of the lowering of the Conway Tubular Bridge into position on March 24. Mr. Robert Stephenson, the engineer, was present and rode across the bridge several times on a locomotive. It is stated that "Although an accurate 'infringement' was used, not the slightest vibration or deflection could be perceived."

In the following issue we read "the Syracuse & Auburn Railroad Company are now engaged with a strong force in substituting the heavy iron rail for the miserable flat bar now in use." The flat bar, it should be mentioned, was a strip of iron nailed down upon the inner edge of longitudinal timbers which took the place of our modern cross-tie.

The editor was already attacking the false idea, that introducing labor-saving machines was prejudicial to the interests of labor. "Proscribe machinery and the farmer might turn over his furrow with his feet and the backwoodsman gnaw down the trees of the forest like a beaver. Abolish labor-saving machinery, and we at once become barbarians."

The SCIENTIFIC AMERICAN had this to say on the refining effect of the arts: "They almost imperceptibly cultivate the general taste and make politeness of mind keep pace with refinement of manners. They are to a highly commercial and opulent state of society what chivalry was to the feudal system."

On the front page of June 24, 1848, we read that the stupendous project of uniting the waters of the broad Pacific with those of the Atlantic by railroad to the Bay of San Francisco, is one of great magnitude, which will and must be yet carried into execution. The editor predicts that not only will a railroad connect New York and San Francisco, but a line of steam vessels will cross the Pacific regularly. "Our country will then become the half-way house of Europe and the land of silk and tea, when New York will become the center of the commercial world."

Evidently we did not have much faith in the future of the gas engine seventy-five years ago; "the exploding of two gases in the cylinder would be of no benefit practically as the expense would far surpass that of steam. Explosive material is of no use as a mechanical propellant. Weight and expansion are our handmaids—these we can control. Whenever steam becomes explosive, we cannot master it."

Seventy-five years ago, the claim of Fulton to be the originator of practical navigation was stoutly sustained by this journal: "It was not until James Watt had greatly improved the steam engine that it was successfully applied to navigation, and it was one of his engines that Fulton applied to propel his ever-to-be-remembered 'Clermont' in 1809." Previous to that, Symington ran a boat on the Forth and Clyde Canal, but it was Fulton who "successfully and permanently established navigation by steam."

The Oscilloscope

A Remarkably Simple Device for Seeing What Cannot Be Seen

IF YOU held your watch in your left hand, in a darkened room, and held in your right hand an electric lamp which flashed exactly once a minute, and if your first flash showed the second hand upon the figure 12, the second flash and all succeeding flashes would show this second hand in the same position. Hence, it would look to you as though the watch had stopped. If, instead of giving a flash every 60 seconds, your lamp gave a flash at 61 seconds' intervals, you would see that the second hand was rotating at its normal speed of once a minute, since every flash would show the hand as having advanced one second in its regular clock-wise direction. On the other hand, if the flashes come at the rate of 59 per minute, it would appear to you as though the second hand were rotating in the reverse direction, or anti-clock-wise.

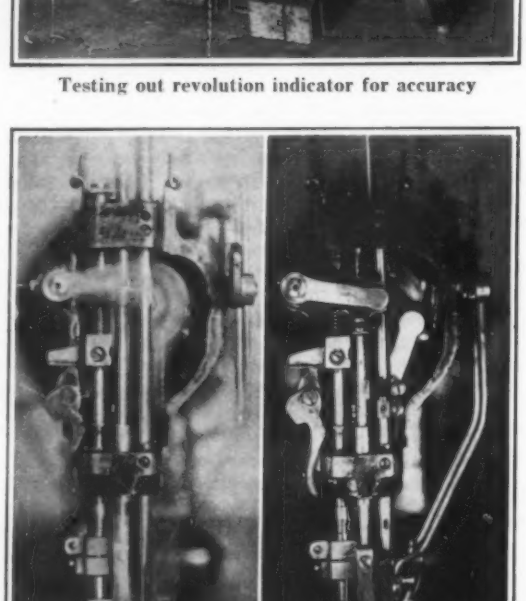
These principles underlie a very ingenious and useful instrument called the oscilloscope, which forms the subject of the present story. Its object is to enable the observer to watch the movement of a machine or its parts, which are under such rapid motion as to present a mere blur to the unaided vision. Essentially, it consists of a special form of flash lamp and a gear-box which is attached to some moving part of the machine to be investigated and is also connected to the make-and-break gear which regulates the periodicity of the lamp flashes.

A machine at rest, and the same moving at any where from 1000 to 20,000 revolutions or reciprocations per minute, present two very different problems. An engineer can see the details of his machine when it is at rest, and the various parts will be in exactly the position and will present exactly the forms as designed: but when the machine is running at high speed, certain undesirable distortions and vibrations may occur. He knows that they are there, his trained ear and his sense of touch tell him this; but because of the high speed of the machine he cannot see their nature or extent.

Now the oscilloscope has been designed to enable him to see these various distortions, vibrations and other irregularities. It does this by slowing down the motion; not the motion of the machine, but the apparent motion, as thrown on the retina of his eye. Although the machine may be running at 1000 revolutions per minute, it is made to appear to him as though it were running at only 10 revolutions per minute, or 1 per cent of its true speed, or even as though it were absolutely at rest.

The means by which this is accomplished are simple and easily understood. First there is a lamp of special construction filled with neon gas, which gives a flash of sharp definition and immediate intensity, without the preliminary red glow and after glow of the ordinary lamp filament. On the gear-box, which is driven by the machine to be examined, is a switch by which the observer can vary the speed ratio between the mechanism to be tested and the flashes of the lamp. This gear-box can control flashes up to 28,000 per minute; so that practically every known variety of high-speed machines can be seen and studied in all its parts, as though it were either moving slowly or were at rest. If the gear attached to the machine has 99 teeth, and it meshes with a wheel connected with the flashing lamp which has 100 teeth, each flash will show the object at an advance of 1/100 of a revolution since the previous flash. Whereas, if the flashes are so controlled that they occur actually at the speed of the shaft, the mechanism will appear stationary in any position desired. A protractor scale provided on the gear-box makes it possible to take actual point-to-point measurements under working conditions.

Testing out revolution indicator for accuracy

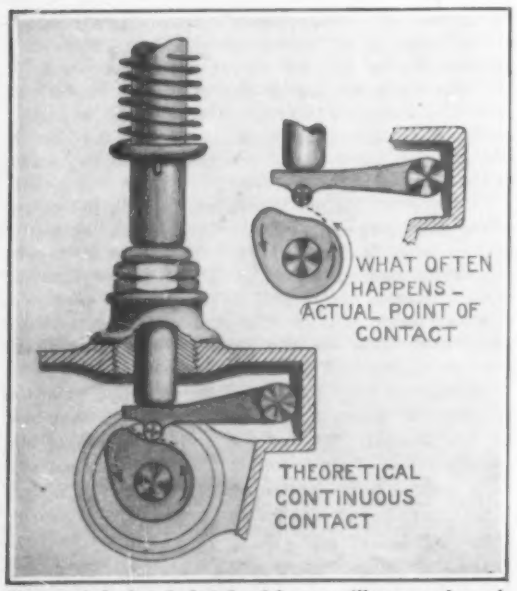


Left: **Sewing machine headstock, by daylight, at 1500 revolutions per minute.** *Right:* **Same headstock, at same speed, by rays of oscilloscope; with moving parts apparently stationary**

We present herewith two views of the headstock of the same sewing machine. The photograph to the left shows the machine running at a speed of 1500 revolutions per minute, and the reciprocating arm near the top and the two vertical shafts present the usual shadowy appearance resulting from the high speed. The photograph to the right was taken by the light of the oscilloscope lamp, which was so geared to the machine that all flashes showed the machine at the same exact point in its oscillation; with the result that although it is running at 1500 revolutions, it appears to be absolutely still. By manipulation of the speed control, the machine may be made to appear to move at any speed desired.

The advantages of being able to follow the motions of a machine which is running too fast for the unaided eye to follow are obvious. Thus it becomes possible to see the extent to which an unbalanced rotating shaft is vibrating about its true axis. The valves of the internal combustion engine are supposed to be alternately raised and seated with great precision; but in watching their operation through the oscilloscope it is found that they may rebound every other stroke and that, consequently, they become fully seated only after bouncing three or four times.

In cotton spinning it becomes possible, by slowing down, to watch the making of the knots and correct inaccuracies. The use of this device in textile printing has proved a great saver of time by making it possible for the operator to look at the moving material without stopping the machine. Another application is in examining the action of lubricants of fast-running machines. Our sketch shows what was discovered to be taking place in the gears of an automobile. The oil delivered to one of the gears was believed to be carried into the other gear, with the result that the whole bearing surface of the two gears was thoroughly lubricated. By slowing down the apparent speed, it was found that the oil was traveling across the width of the cam-shaft gear; the successive stages of its passage being shown in one of our sketches. The effect of this was that the oil was forming in globules on the face of the teeth of the magneto wheel, and none of it was entering the mesh. By changing the position of the delivery pipe, as indicated in the sketch, correct lubrication was at once arrived at.



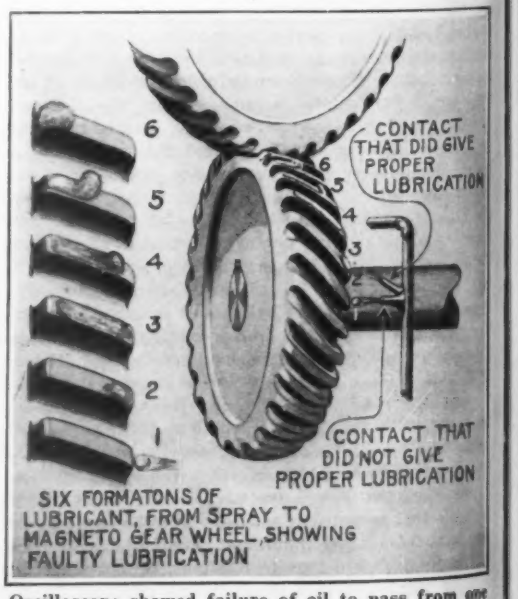
Upper right-hand sketch of how oscilloscope showed valve stem, etc., jumping clear of cam

L'Indicateur Aerien

AS we write, we have before us a 48-page timetable of aerial services, from which we glean the following information as to prices based on current rate of exchange:

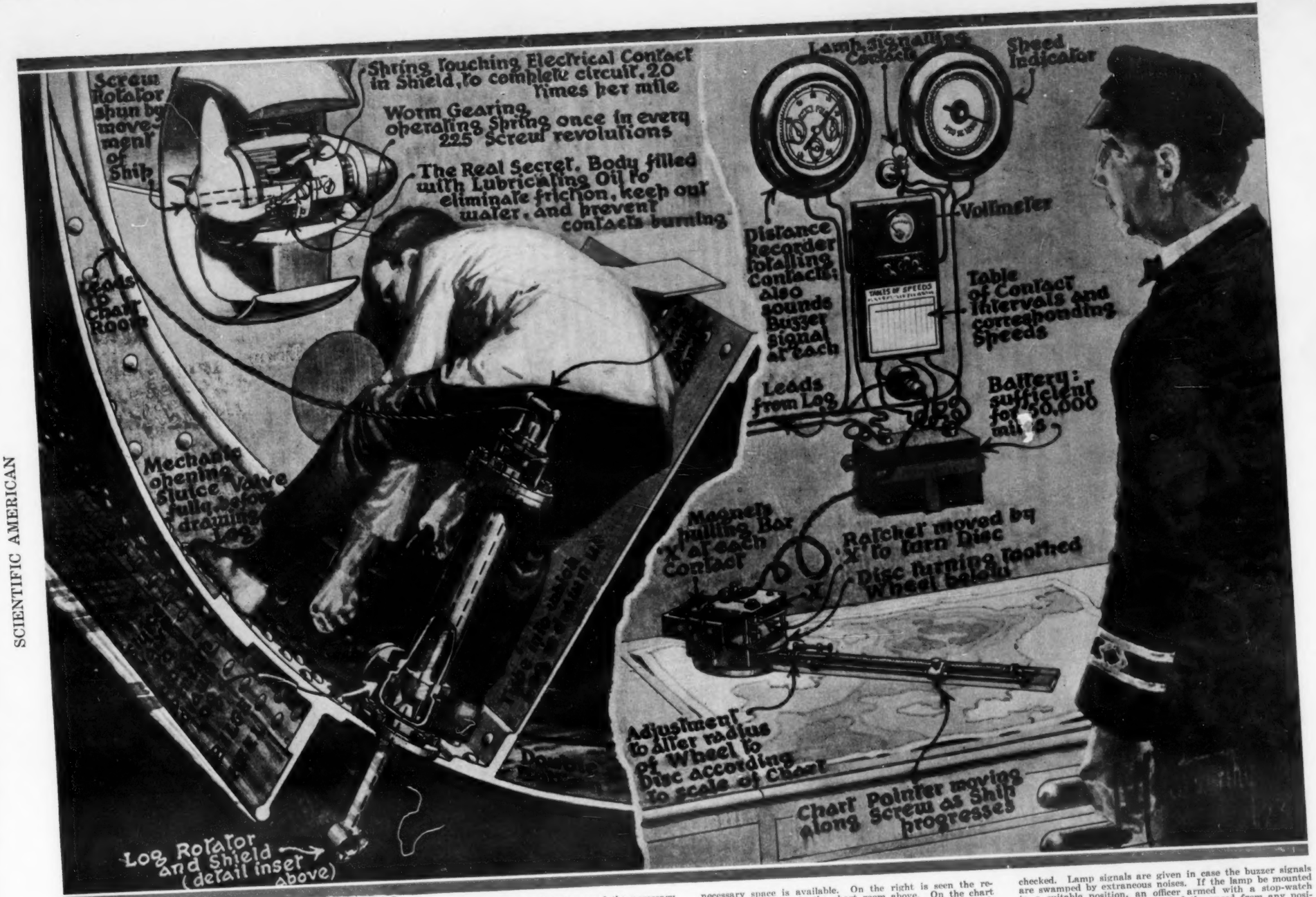
Paris—Havre	$15.92
Paris—London	23.88
Paris—Brussels	13.93
Paris—Amsterdam	23.88

If you want to go to Switzerland, and wish to avoid the long ride by rail, why not take a Goliath Farman, with 11 other passengers, at 9, and lunch at Lausanne at 12, for $25.87. If you wish to go to Vienna the fare would be $51.40, but this compares very favorably with rail, as you have to have sleepers, first-class fares, and supplemental payments, which swell the total for a very long and expensive journey. Leaving Paris at 6 A.M., you arrive at Prague at 13 o'clock, and after a half hour's delay you arrive at Vienna at 15:30 o'clock, or 5:30 as we measure time, or less than 12 hours for the entire journey, including one hour's stop at Strassburg and Prague. If the Riviera calls you, and you do not wish to travel on the very comfortable "P. L. M." railway, you can travel by air for $43.78—a little high, perhaps, but a great fatigue saver. The line from Toulouse to Morocco is well patronized and is economical of wear and tear, for the railroads in Spain are none of the best. The total expense is 840 francs, or $66.16, certainly a considerable sum, but on the map, tracing from Toulouse, Barcelona, Alicante, Malaga, to Casablanca, it seems well worth the price.



Oscilloscope showed failure of oil to pass from one gear to the other

AN ELECTRIC SPEEDOMETER FOR SAFE SHIP NAVIGATION; THE NEW ELECTRIC SUBMERGED LOG


Screw Rotator shun by movement of Ship
Spring touching Electrical Contact in Shield, to complete circuit, 20 times per mile
Worm Gearing operating Spring once in every 225 Screw revolutions
The Real Secret. Body filled with Lubricating Oil to eliminate friction, keep out water, and prevent contacts burning
Leads to Chart Room
Mechanic opening Sluice Valve fully before drawing Log
Log Rotator and Shield (detail inset above)
Lamp-Signalling Contacts
Speed Indicator
Voltmeter
Distance recorder totalling Contacts; also sounds Buzzer signal at each
Table of Contact Intervals and corresponding Speeds
Leads from Log
Battery sufficient for 50,000 miles
Magnets pulling Bar 'X' at each Contact
Ratchet moved by 'X' to turn Disc
Disc turning toothed Wheel below
Adjustment to alter radius of Wheel to Disc according to scale of Chart
Chart Pointer moving along Screw as Ship progresses

Drawn by our British artist, S W. Clatworthy. Copyright in U. S. A , Scientific American Pub Co.

AN ELECTRIC SPEEDOMETER FOR SAFE SHIP NAVIGATION: THE NEW ELECTRIC SUBMERGED LOG

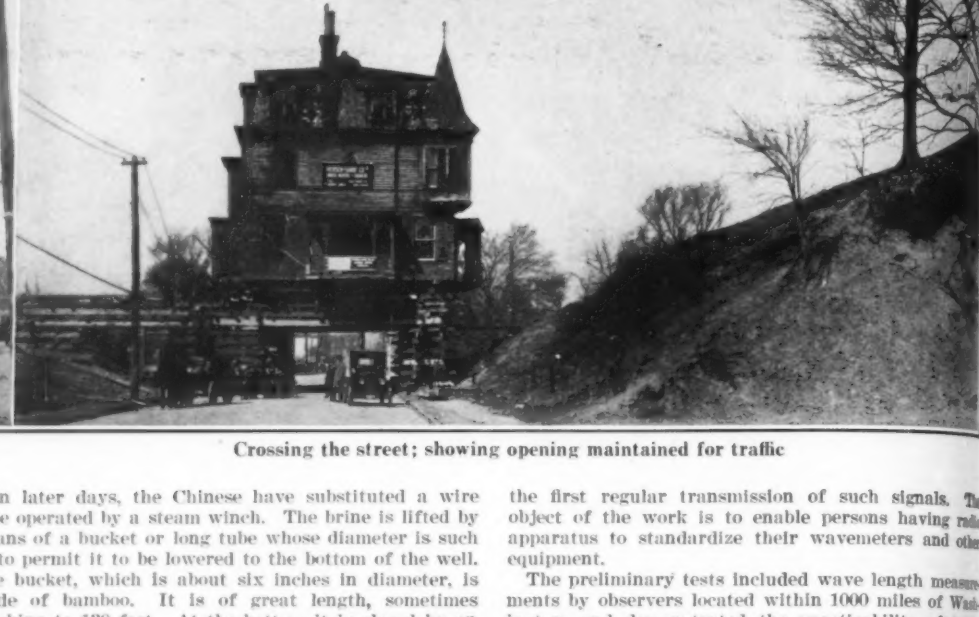
IN misty weather, especially when working inshore, a navigating officer must know the exact position of his ship at any moment. He calculates this from the speed recorded by his log. Unfortunately the usual device, a taffrail indicator with towing line from the quarter, operating in the turbulent wake, is never quite accurate and is least reliable at the low speeds which occur at such critical periods.

Many ingenious substitutes have been produced—mechanical, electro-mechanical, or hydraulic—without real success. Mechanical logs are subject to varying friction at different speeds, with consequent false registration, and the necessary constant adjustment falsifies the calibration.

International tests of various logs were recently carried out on the British submarine "K-14," when the new electric submerged log, invented by Capt. Chernikeeff, hydrographer to the late Russian Government at Sevastopol, earned the approval of the Admiralty and is now being fitted in some men-of-war. It recorded accurately at all speeds.

On the left of our drawing the ingenious log itself is seen, fitted in a liner, through the engine room shell, where the necessary space is available. On the right is seen the recording installation in the chart room above. On the chart itself is a further device, termed a "coursograph," which automatically registers the ship's progress so that the officer—or owner, if a yacht—can immediately ascertain his exact whereabouts by a glance at the pointer, together with such information as the chart affords, such as depth of water, etc. By timing, with a stop-watch, the duration of the intervals between contacts and referring to the table of corresponding speeds, the accuracy of the indicators may be checked. Lamp signals are given in case the buzzer signals are swamped by extraneous noises. If the lamp be mounted in a suitable position, an officer armed with a stop-watch and a copy of the tables can find the speed from any position in a big ship. Again, by fitting contacts on the pointer slide of the coursograph, to close when the pointer reaches them, an electric bell may be made to ring in the captain's cabin at any predetermined point where he may have decided, upon the ship's arrival, that his presence upon the bridge was necessary.

Perry Mansion moved to the edge of the roadway



Crossing the street; showing opening maintained for traffic

Curious Feat of House Moving

IN the opening up of old residential property, by grading the streets and laying sewers, and water and gas mains, it is customary to make a fairly clean sweep of the existing brick and timber residents. On the other hand, a house may be so well built and in such excellent order as to make it worth while to preserve the building and move it to some suitable lot in the redeveloped property.

Now this is what has recently occurred in the development of the "Perry Estate"; the last remaining large tract in the well known Bay Ridge district, fronting on New York Bay. It was decided to preserve the old "Perry Mansion" and move it from its original rather lofty elevation to a new and somewhat lower site on the opposite side of the street. The mansion measures 34 feet by 66 feet, and, as it is three full stories in height and is heavily built and brick lined, its weight is large, and considerable skill was required in making the transfer. The problem was complicated because of the fact that the house had to be moved across a thoroughfare, which it was necessary to keep open for traffic.

The first step was to lift the house clear of its foundation and place it upon blocking. This blocking was subsequently extended to the edge of the nearer sidewalk and the house was moved on rollers until it had reached the roadway and stood at an elevation of 28 feet above the street. Here, by the removing of part of the blocking it was lowered to the level of the bank on the opposite side of the street. A similar mass of blocking was built out from the opposite side of the street, leaving a gap wide enough to accommodate the street traffic. This opening was then bridged by the long heavy timbers shown on the illustration, and the house was drawn across the bridge until it reached its new site, 200 feet distant from its original foundation. We are indebted for our information to the courtesy of Mr. Wm. Laemmil of Brooklyn, who informs us that the contractors made such a good job of their work that no cracks or any other evidence of its journey were discernible in the 60-year-old house.

Chinese Drilling for Salt

IF any one told you that he knew of a coal mine which had been working from the third century B. C., you would begin to have doubts as to his veracity—unless indeed the location were in China, where evidences of antiquity are so prevalent. Here, in Szechwan Provance are situated the ancient salt wells of Tze liu ching, which first were worked about the third century, B. C.

The present wells are about nine inches in diameter and have been sunk to a depth of from 2500 to 5000 feet, and, of course, they have taken many years to dig or drive, with the primitive methods used by the Chinese. The brine, which varies from yellow to black in color, the black brine containing the most salt, is raised to the surface in the following manner:

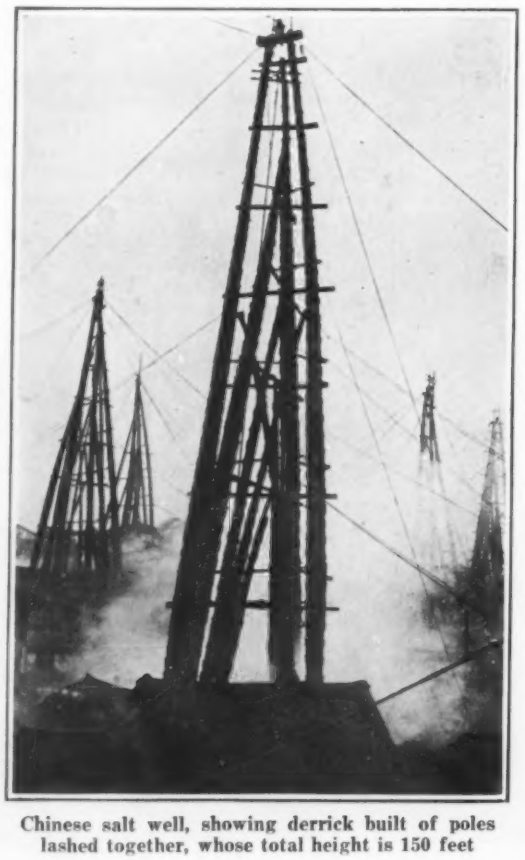
Above the head of each well is erected a large gantry, similar to those which are built over oil wells, which in some cases reaches a height of 150 feet. The separate legs of the gantry are built up of clusters of pine-tree poles firmly lashed together at frequent intervals. Directly above the wells and at the top of the gantry is a large sheave, and over this, in the older wells, used to pass a bamboo rope, which was brought down to a large horizontal windlass, turned by means of water buffaloes. In order to get any reasonable speed in raising the brine, the buffaloes were flogged into a trot, and, therefore, their span of working life was very short. It was an expensive method of raising the brine.

In later days, the Chinese have substituted a wire rope operated by a steam winch. The brine is lifted by means of a bucket or long tube whose diameter is such as to permit it to be lowered to the bottom of the well. The bucket, which is about six inches in diameter, is made of bamboo. It is of great length, sometimes reaching to 130 feet. At the bottom it is closed by an inwardly opening flap valve, which opens as the bottom of the bucket passes down through the brine, and closes as the bucket is lifted. When the lower end of the bucket is clear of the top of the well, it is pulled to one side, the flap valve is lifted and the brine runs off into vats, from which it is taken to evaporating pans where the solid salt is secured.

Many of the wells of the Tze liu ching contain a natural gas, which is used in the process of evaporation; but where there is no such gas, coal is the fuel. There are hundreds of these wells in the district, and they give employment to scores of thousands of people. The output exceeds 100,000 tons per annum. We are indebted for our photographs and particulars to E. J. Jukes Hughes, Commander, Royal Navy.

Transmission of Standard Radio Wave Length Signals

ON January 29 and 30, the Bureau of Standards conducted preliminary tests to determine the practicability of regularly transmitting signals of known wave length. This was followed on March 6 and 7 by the first regular transmission of such signals. The object of the work is to enable persons having radio apparatus to standardize their wavemeters and other equipment.



Chinese salt well, showing derrick built of poles lashed together, whose total height is 150 feet

The preliminary tests included wave length measurements by observers located within 1000 miles of Washington, and demonstrated the practicability of transmitting such waves. In general, the results were in fair agreement, but differences as high as 7 per cent existed. Wavemeters ought to be in closer accord than this, and it is hoped that this system of standard wave transmission will result in more accurate measurement and adjustment of radio apparatus of all kinds.

From the information obtained, it appeared desirable to transmit standard wave signals after 11 o'clock P. M. Eastern Standard Time, when broadcasting stations are through with their programs. Therefore, the first regular transmission of standard waves on March 6 and 7 took place from 11 P. M. to 1:15 A. M., and included wave lengths from 550 to 1500 meters.

The general call for the transmission of standard wave lengths is "QST de WWV Standard Wave Signals" repeated, and will be on the same frequency as the test signal. The standard wave signal will be "WWV" repeated.

In the announcements, the wave length of the test signal will be stated. The general call and announcements will be made by both radio telephony and radio telegraphy. For the standard wave signal and for announcement by radio telegraphy, unmodulated continuous waves will be used. Announcement of later transmissions of standard wave lengths will be made in the press and in the Radio Service Bulletin. The transmission planned for the immediate future will be on shorter wave lengths than those of March 6.

United States Government Specifications for Dry Cells

CIRCULAR No. 139 of the Bureau of Standards, for sale by the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents per copy, contains specifications for dry cells, flashlight batteries, and radio B batteries. The dimensions of the standard sizes are given, followed by a discussion of standard tests and the minimum required performance for each of the standard sizes. Dry cells in excess of 100,000,000 are used annually in this country, and although certain sizes have predominated, a large number of relatively unimportant sizes have been made.

In an effort to standardize the more important sizes, the Bureau called a conference of the leading manufacturers and largest individual users of dry batteries to meet with representatives of the various Government departments in December, 1921. The conference considered 17 different sizes of dry cells, and standardized seven of these sizes. Out of 30 different sizes of flashlight batteries, eight were adopted as standard. It considered assembled batteries of the larger cells for ignition and similar work of which there are approximately 30 different sizes being made at the present time, and chose six of these as standard. Two sizes of batteries for use with radio apparatus were also standardized. It is expected that the elimination of many sizes for which there is little demand, and which will no longer be considered standard, should result in considerable saving in the cost of manufacture and increase the convenience to the public.

A description of the manufacture and electrical characteristics of dry cells has been published in the second edition of Circular No. 79 of the Bureau of Standards. The price of this publication is 10 cents.

Our Psychic Investigation in Europe—II

A Sitting with William Hope, Psychic Photographer, and a Discussion of Its Result

By J. Malcolm Bird

Associate Editor, SCIENTIFIC AMERICAN, and Secretary of the SCIENTIFIC AMERICAN Psychic Investigation Committee

FOLLOWING Mr. Bird's article under the above heading in our May issue, we present here the second of the series in which he will set forth what he witnessed on his recent flying trip to points of psychic interest in Europe. Mr. Bird is now with us again, having returned on the "Olympic," early in April, in company with Sir Arthur Conan Doyle, through whose introduction he penetrated to British mediumistic circles which would have been closed to the ordinary outsider. Because of the very great interest taken by press and public in the "psychic photograph" obtained in his presence by William Hope, the British photographic medium, Mr. Bird has departed from the strict chronological order to describe in this issue his sitting with Hope.—THE EDITORS.

OUR REGULAR readers will recall that last fall we gave an account of a photographic seance with William Hope, held by the British S. P. R. under the direction of Mr. Harry Price. They will recall, from a later issue, a letter by Conan Doyle, in which responsibility for the substitution of plates at this seance was shifted to the shoulders of the investigators. Further letters from Mr. Price and from Mr. McKenzie of the British College of Psychic Science have urged us to give more space to the controversy. This we have refused to do. Both parties were so negligent in safeguarding their interests at the time that it is impossible at this date to arrive at the truth; while the manner in which the dispute has degenerated into a battle of abuse makes it unprofitable to try. I refer to the incident here only to make it clear that Hope has entered a defense. Were this not the case, I should perhaps not have sat with him; as things stood, I seized the opportunity which presented itself on Tuesday afternoon, March 13, the eve of my departure for the continent.

Hope sits at the British College, in London, in quarters specially reserved for him. The college gets two guineas for a sitting, of which something like four and eightpence goes to Hope and the balance to the support of the college. This curious charge has been determined by Hope on the basis of his trade as a carpenter. He has estimated the time consumed by a photographic seance, and has calculated the amount he could earn at the bench in this time. So much he feels he must charge, but he does not care to charge more. The statement that he does not profit from his photographic work seems therefore a fair one.

Hope is only half a medium. The other half is Mrs. Buxton. They will tell you neither can produce a psychic photo in the absence of the other. On general principles this is obviously objectionable and suspicious. But the technique of the sitting is such that Mrs. Buxton could hardly commit any fraud which Hope, working alone, could not equally well commit. The investigator suffers from division of his attention between the two, but beyond this I do not see that Mrs. Buxton's presence can have bearing upon the genuineness of the phenomena. In a series of test sittings, an additional investigator would, of course, be present to give her his entire attention.

His recent imbroglio has made Hope realize that test conditions are his only protection. Hence he now sits only with control substantially the same as that applied at my seance. This starts with the purchase of the plates, which Hope now requires to be brought in from outside. On the morning of the seance day I secured, at the Westminster Photographic Exchange in Victoria Street, a package of rapid quarter-plates; and these I took with me to the sitting, in the original wrapper and seals.

There were to be present Sir Arthur Conan Doyle and myself, with Sir X. Y. Z. and Lady Z., friends of the Doyles. We four taxied out to Holland Park, which with characteristic London perversity is not a park at all, but a street. Sir Arthur was very perturbed by the muggy weather. It appears that of plates exposed by Hope, about one in seven shows a psychic extra. One never knows whether one will draw a blank or not; and damp weather is supposed to interfere greatly with the exercise of any psychic powers.

The Z's and I were introduced to the mediums by name; my identity and my profession were not mentioned. Both Hope and Mrs. Buxton, if I may say so, are quite ordinary folk. It is "old stuff" to say that they seemed incapable of the sustained elaborate fraud which would be necessary to account for their results, but this is one's most pressing thought in dealing with them.

Examination of the premises and equipment was a simple matter. Hope has two small rooms on the top floor, one serving as the studio and one as dark room. The only entrance to the suite is through the studio. This room is furnished with a bare table, a few chairs, and the oldest, most disreputable camera in the world. When I mention a single large washing basin, three developing trays, three jars of chemicals, one glass beaker, three plate holders, and two red lamps, I have cataloged the equipment of the dark room. I cannot imagine a photographic studio more meagerly equipped, or a photographer of more mediocre attainments.

While I am no professional photographer, I believe I know what to look for in examining a camera for evidences of fraud; both lens and box got my attention, and revealed nothing objectionable. Hope uses no shutter, nor even a lens cap; he makes his exposures by covering and uncovering the lens with the black focussing cloth. Accordingly I examined this, with negative result again. I was invited to select one of the three plate holders; the chosen one I examined with extreme care. It had been thoroughly marked by previous sitters, and substitution could hardly have been attempted. From the time of my examination until that of use, it remained in my pocket.

The six sitters now drew up to the table, and the door was locked. The packet of plates, still with its original wrapper unbroken, was transferred from my pocket to the table. The six of us joined hands about the table, and hymns were sung, without music, to the best of our very poor ability. Once or twice Hope or Mrs. Buxton interpolated a prayer. Presently Mrs. Buxton took the package between her hands; Hope added his outside hers; and all the rest of us followed suit. The package remained above the table and in plain sight here, in its nest of hands. The pose was held for several minutes while Mrs. Buxton, apparently in silent prayer, "influenced" the plates. It was explained again that we might draw a complete blank, and speculation was indulged in whether we should get anything better than this. At a word from Hope, the preliminaries were ended; I regained and identified my package of plates, and adjourned to the dark room with Hope. During this "influencing" of the plates, Mrs. Buxton was observed to give a convulsive shudder, which Sir Arthur announced to be an almost certain sign of impending success.

In the dark room, Hope did not touch the plates—on this point I must insist. He stood at my shoulder, superintending my manipulation of them and occasionally offering a suggestion; but did not offer at any time to do more. I took the package from my pocket and broke the wrappings. Before I got to the plates, Hope suggested that I decide now which of the twelve I should use. I chose the second and third from the top. When I had got the four topmost plates out of their common inner wrapper, I separated the second from the first and the third from the fourth, with some difficulty. As I got each of the desired plates free, I signed my name with lead pencil upon the emulsion side. I then drew the holder from my pocket, loaded it with the marked plates, the dark slides, etc., latched it, and put it back in my pocket—again without its being touched by Hope. We then left the dark room.

Sir Arthur and I were to sit for the first exposure, and I alone for the second. Hope focussed the camera upon the empty chairs, and called me to verify the range and direction. He shifted the hood to the front of the camera; I placed the plate holder in its seat and removed the dark slide. I then went to my chair; Hope raised the hood, held it clear of the camera's eye for about 15 seconds, and dropped it back. During this time, he and Mrs. Buxton stood at either side and

This portrait of Mr. Bird and Sir Arthur Conan Doyle, sitting together, was taken immediately before the picture of Mr. Bird sitting alone. There was no opportunity to change the camera in any respect between the two exposures, the conditions being identical save for the reversal of the plate holder. Mr. Bird's signature identifying the plate is seen here as in the other photograph, but there is here no trace of any abnormality

Print from first negative exposed by Hope

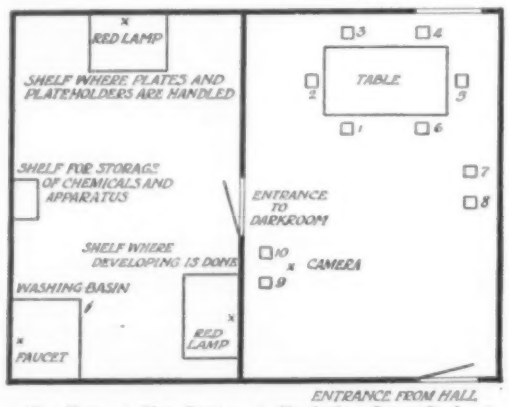
The "psychic photograph" of Mr. Bird made by William Hope on March 13. In addition to the signature that marks the plate as one which Hope had had no opportunity to prepare, there appear two extra faces—one quite distinct and one less clear; and in addition, three marks of still more indefinite character. Neither of the extra faces has been recognized as that of any person, living or dead, known to any of the six persons present

Print from second negative exposed by Hope

slightly behind the camera, with hands joined above it, and Mrs. Buxton's free hand resting lightly upon it.

The exposure terminated, I rose to replace the dark slide, reverse the plate holder, and remove the other dark slide. I resumed my seat, and the second exposure was made. I then replaced the dark slide, removed the plate holder, placed it in my pocket, and once more was accompanied by Hope to the dark room. If I were sitting for a series of these tests, I should require the medium to stay out of the dark room for some at least of the series; his presence, no matter how strongly one may urge his inaction, will always be attacked, and the very pertinent question proposed: "What was he doing there; why didn't he stay outside?" In the present case, this question is easily answered; he didn't stay outside because he was as much privileged to regard me with suspicion as I, him.

Hope got down his beaker and his two jars, and mixed his developer. He was ready with it before I was ready with the plates; to keep him busy, I managed to knock it over with my elbow, and he had to mix it afresh. When it was ready the second time, I had the plates out of the holder and in the developing tray, so I poured the contents of the beaker over them with no further catastrophe. The precaution was perhaps superfluous, but at any event was harmless. As I rocked the tray, the images came out rather slowly; but it was soon evident that while the plate showing Sir Arthur and myself was quite normal, the other was going to show some extras.



1, Mr. Hope; 2, Mrs. Buxton; 3, Sir Arthur Conan Doyle; 4, Sir X. Y. Z.; 5, Mr. Bird; 6, Lady X. Y. Z. These were the positions occupied during the preliminaries. For the actual photography, Sir Arthur occupied a chair at 7 and Mr. Bird at 8; while Hope stood at 9 and Mrs. Buxton at 10. In the dark room, the plates were handled before and after exposure only by Mr. Bird, working first at the end of the room and then in the corner behind the door, as the legends would indicate

The general arrangement of William Hope's photographic studio and dark room at the British College of Psychic Science, in London; and the places occupied by the mediums and sitters at the seance of March 13, 1923

Development completed, the negatives were placed in the fixing bath and a report made to those in the studio. All waited in great tension until the fixing was completed; and then were disappointed to find that, from the negative, one could not say whether one knew the two clear extras or not. Prints would not be ready until next day, and I was under the necessity of leaving London for Paris that evening. It was arranged that prints should go to Sir Arthur, who would hand them to me on board the "Olympic." As a very special concession, quite opposed to the routine of the college and, I believe, never before made, it was agreed that I might have the negative, too. I examined it very carefully before leaving it, and again, two weeks later, on getting it back. It had not been altered in any respect; the reproduction herewith represents it in its original state. In view of the fact that for two weeks the entire apparatus resulting from this sitting was out of my control, this statement is not entirely superfluous.

The prints have been examined by all six sitters, and neither of the extras has been recognized. This result is not unusual; in only a minority of cases is the "psychic extra" identifiable as pertaining to one of the sitters.

The photograph reproduced herewith is either a genuine psychic phenomenon, or else it is a fraud. One who takes it to be a fraud must make a plausible showing as to how it could have been produced. The negative carries my signature, so the hypothesis of plate substitution will not do. If it be urged that my examination of the camera may have been faulty, it must be explained how the picture of Sir Arthur and myself, taken with the camera in the same condition, escaped the "extra." This point may be met by assuming that the secret lay in the plate holder, which was, of course, reversed after the first exposure. If I am not capable of examining a trick plate holder, this hypothesis may be maintained; but I would point out that even if I am not, Hope does not know this, and he *did* know that the holder was to be examined. If fraud were practiced, I think it probable that it was in some direction to which it might reasonably be hoped that examination would not extend.

Hope's person is one such direction; he was not to be searched, and he knew this. At any time in the dark room, could he have exposed the plate to the extra, without my detection? The plate was a fast one, to be sure; but in a room receiving fair light from outdoors, and equipped with several ordinary incandescent lamps, a 15-second exposure was not excessive. Some of the marks on the plate could be called flashes, but at least one of the extras shows far too much detail to justify any such designation. Moreover, if trickery were practiced, the trickster would have to bargain on movement of the plate as I worked with it. On all these grounds, a pretty intense luminous effect would necessarily have been employed. But Hope's dark room is very dark indeed; and the probability seems small that he could have used anything of sufficient brightness and duration to impress the plate, without impressing my eye at the same time. Descending to specific suggestions, I urge our experience with Father de Heredia (below) against the possibility of luminous paint, etc.; and the fact that one of the extras shows considerable internal detail, against the theory of an electric torch with a silhouette pasted upon the lens.

The theory that X-rays or something of the sort may have been used in the studio, before opening the package, I can dispose of categorically. After my two exposures, Sir X. Y. Z. and his Lady sat twice. They used plates from my package; they got no extras, and no extraneous mark of any description.

In the face of all this, fairness demands that I quote the opinion of a photographer of long experience, who has handled the originals and several reproductions in connection with the making of the half-tones. He insists that the extras are luminous finger-prints, the better one coming from a finger on which a crude face had been painted. How they got on the plate I leave it to him to struggle with. Perhaps he will maintain that they are from my fingers. Another admission which ought to be made is this: Under repeated reproduction, the extras show a marked tendency toward grain. Sir Arthur has a lantern slide, made from a print from the original negative. From this slide, a new glass negative has been made, by photography with transmitted light; and in prints from this the best extra looks like a very coarse newspaper half-tone, the grain being the most prominent feature. Examining the original under this suggestion, one realizes that in it, too, the extra is not quite so free from grain as the rest of the picture. This may or may not be significant; supporters of the genuineness of the picture will attribute it to the fact that the process of getting the extra on the plate is admittedly and necessarily different from the process of normal photography by which the balance of the plate was made.

Of all suggestions of fraud, the least improbable, in my judgment, is that by some secret and well concealed optical arrangement, an extraneous image was projected along with the normal image of me, through the camera's eye and upon the plate. There was certainly no apparatus inside the camera by which such an image, coming in obliquely, could have been turned along the lens axis; if this procedure were used, the trick image came straight into the camera, from in front. The wall behind me was quite dark, and apparently unsuitable as a screen from which such an image might have been reflected. At the same time, the completed picture unquestionably shows light marks which, along with the poorer extra, might be interpreted as an image of the path, in the suspended atmospheric dust, of a light-beam thrown upon the wall behind me, from a corner of the room. If the difficulties of the final reflection from the dark wall into the camera can be met, together with those of concealing the beam and its source from my observation, this suggestion is at least not further contradicted by the picture and its mode of production.

A New York photographer insists that, if this beam were of ultra-violet rather than of visible light, the dark wall could have been chemically treated so as to act as a reflecting screen, without any effect visible to the eye; while, as regards the light track on the plate, the camera would presumably be as sensitive to dust-scattered ultra-violet as to dust-scattered light of the visible spectrum. This offers perhaps the best hope of explaining the picture on "rationalist" grounds. The chief obstacle is that the apparatus would cost about a thousand dollars. Certainly Hope couldn't buy it; I doubt that the British College could; and if it could afford it, I doubt that the college could obtain the instrument from any firm of such low standing that it would dare approach them on the subject. Moreover, all sources of the ultra-violet emit freely the visible wave-lengths as well; and I am not wholly satisfied that these could be filtered out, leaving enough ultra-violet for rapid photography.

It is very easy, in fact, to point the finger of scorn at any alleged psychic phenomenon, and to say that in such-and-such a way it could have been fraudulently produced. It is not always so easy to come right down to the point and duplicate the given result in the given manner. I can illustrate this no better than by reciting our recent experience with Father C. M. de Heredia, S. J., a prominent scoffer at the psychic, author of the volume "Spiritism and Common Sense," and a good friend of our staff in spite of any divergence of opinions.

Father de Heredia read in the dailies of April 5 a brief account of my Hope picture. He was at our office early the next morning, prepared to show us how it was done. He was going to puzzle us completely; we weren't going to have any notion of how he did it until he told us; his result was going to be fully equal to Hope's. We led him into our photographic studio and told him to go as far as he liked.

We had no plates as fast as those used by Hope, but we selected two of the speediest we had. In the normal part of the sitting, they required an exposure of 20 seconds or a bit more; with this, they produced excellent photographs. Father de Heredia emphasized that he was going to proceed just as Hope had proceeded; so the first thing was for me to autograph the plates while he stood in the background. But—then he stepped forward, to sign them himself as well. He placed his elaborate signature on each plate, resting his left hand the while, quite naturally and unostentatiously, palm down on the surface of the plate.

Both Mr. Lescarboura and I tried to stop the good Father here, with the statement that we knew substantially what he was doing, that he obviously had in his hand a luminous object of some sort, that it was quite superfluous for him to go on, and that in fact he had departed in a very vital manner from Hope's procedure. But he wouldn't stop. No, no, he insisted; he would go right on, anyhow, and get through with the experiment and exhibit his result.

The camera was therefore loaded, and the three of us sat twice for a group picture, with our staff photographer at the camera. On development both plates showed an extra — a faint white smudge across my chest, recognizable by a leap of the imagination as the silhouette of a face and shoulders. There was absolutely nothing but the white silhouette—no attempt at internal detail. It was so faint that the negatives had to be fully developed and held against the light to show that it was there at all. It is so preposterous to compare this result with that obtained by Hope in my presence, that we do not even give space for a reproduction of one of these pictures; they simply aren't in the same class.

Father de Heredia, however, was greatly pleased and no little excited. He proceeded to "show us how it was done." Here a further departure from Hope's technique appeared. The luminous paint with which he had coated a portrait of Admiral Beatty was of such sort

(Continued on page 428)

APART from what he may have learned regarding advantageous seance procedure, it is to be emphasized that Mr. Bird's mission in Europe has no connection with our American investigation, with our offer of $5000 for genuine physical manifestations of psychic powers, or with the work of our Committee of Judges in that investigation. Mr. Bird went to Europe merely to get, for presentation to our readers, first-hand personal impressions as to the nature of these physical phenomena, about which so much has been written and so little really understood. His mere description of the wholly unscientific conditions under which he sat would alone make it plain that nothing further than this could come out of his experiences.—THE EDITORS.

Stretching the Gasoline Supply

JUST what effect upon the running of the car does the gasoline of today have, as compared with that of a few years ago? That starting the motor is more difficult may be taken for granted, but the development of the self-starter has largely enabled us to keep up with this deficiency. But given an engine that has been started and well warmed up, is the gas of today, with its high-boiling, low-volatile quality, an objectionable feature?

The Federal Bureau of Standards is working out an answer to this question, basing their results on the use of four different grades of gas used on the motor of a car running on the road rather than in the laboratory. Of these four grades of gas, one is the average gas purchased today at the curbside pump, another is the grade which was on the regular market four years ago, while the remaining two samples were chosen with a view to the grade of gas we shall probably be using in the future, being much heavier fuels than are now in regular use. One of these is chosen as being of about the lowest grade that the Government experts dare expect to be in use in the future for the motor car. If such a fuel as the latter can be used, it will indicate that our gasoline production can be increased by no less than 27 per cent. Such an increase in the amount of motor car fuel to be distilled from the crude oil would lower the cost of the fuel enough to make up for the shorter life of starting batteries which would be brought upon them by starting cold motors with such gas.

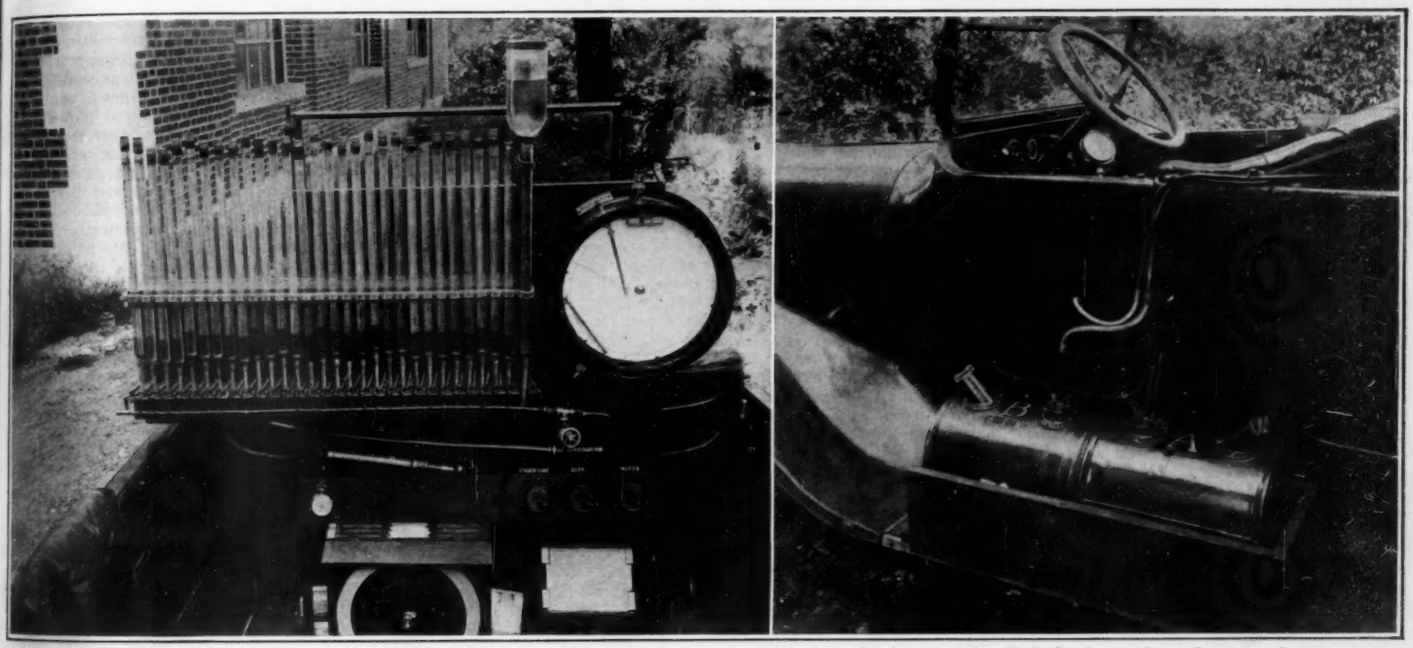
Road tests were made, using these fuels over a 3.2-mile course in Washington. This route was divided by prominent marks, into 32 equal sections, each one-tenth of a mile in length. The test cars were speeded and slowed as far as possible, in imitation of ordinary city travel. All accelerations were made with wide open throttle, all decelerations with closed throttle, without braking. This insured uniformity of conditions in all tests. The carbureter was adjusted to develop maximum power on the particular reference fuel being used during a given period of time. Six runs were made daily, each of the four different fuels being used in its turn as a reference standard, the remaining three undergoing comparison tests.

Since one of the things which must be observed with extreme accuracy is gasoline consumption, means must be provided for accurately reading this at one-tenth-mile intervals, and while on the fly. This is accomplished by piping the fuel from the general tanks to a battery of 32 burettes mounted in the tonneau. These tubes are so arranged with stop-cock and carbureter connections that can be used, in order, for the 32 sections of the run. When the run is finished, the series of readings can be made by measuring the amount of gas that has been run out.

A recording vacuum gage is connected with the intake manifold, and its record of the vacuum present in turn indicates how the throttle valve was handled during the runs. In connection with this, a recording tachometer gives graphs showing the increases and decreases in car speed. Special recording thermometers put down the temperature of the outgoing water, crankcase oil and differential lubricant, as well as that of the atmosphere and the intake air. Record is kept of the relative humidity and the barometric pressure.

As a result of these tests it is quite probable that we can use a lower grade of gasoline, and therefore a cheaper and a more plentiful one, and furthermore that the way will be shown for making the available fuel more efficient as regards both power and mileage. To date, four cars of different and well-known types, together representing 75 per cent of our total production of automotive vehicles, have been experimented with. One complete series of runs has been made with the engine cooled down to 35 degrees Fahrenheit before every start; a second series with the engine idling at ordinary operating temperatures for a starter; a third series with the engine warmed to the fixed temperature of 185 degrees in advance of the test.

Summer tests showed that all four fuels give about the same mileage per gallon when each is handled in the manner best suited to its individual temperament. This proviso of course is important, because change from one grade of fuel to another calls for a carbureter adjustment which in commercial practice it does not usually get. Tests are now under way with the motors running under dynamometer loads, in sealed chambers where the temperature can be controlled in imitation of winter conditions. If the heavier fuels stand up under these, it will be in order to consider steps for getting them on the market and getting the motoring public educated to their use.



Left: **The battery of 32 burettes of gasoline mounted in the test car. Recording instruments show how the throttle is handled, the fluctuations of car speed, temperature of cooling water, lubricants and atmosphere, as well as humidity and barometric pressure.** *Right:* **Two five-gallon tanks supply the special test fuels for the experiments**

Gasoline and Alcohol As Fuels of the Future

BEFORE prohibition the per capita consumption of gasoline and alcoholic beverages was about the same, 20 gallons a year. Now the consumption of alcoholic beverages is theoretically reduced to zero, while the consumption of gasoline has risen to 77 gallons per capita. However, we may live to see these ratios reversed and gasoline decline, while alcohol rises until vastly more alcohol is manufactured. As soon as men get accustomed to regard alcohol as fuel instead of as food, the vexatious restrictions that have been imposed upon its manufacture and sale for the last 500 years may be removed. When that day comes the Government will be urging people to set up home stills instead of confiscating them, and this will enable spoiled grain, unsalable fruit, sawdust and all sorts of wasted stuff to be converted into power on the spot.

Alcohol can be made out of more different things than almost anything else in the world. Any sugary, starchy or woody material can be converted into alcohol, directly or indirectly.

But if we have to shift from gasoline to alcohol we shall have to hunt for the cheapest and most abundant material to make it from, and it is high time that the hunting began. The saving of waste foodstuffs would not suffice. If we used corn it would take more than a quarter of our corn crop to make enough alcohol to take the place of the gasoline now used and we shall want to use more in the future as our desire for power increases.

Probably it will be found that the tropics will grow the largest crops of saccharine material suitable for alcoholic fermentation in a season and, if so, this neglected region will assume the importance that the coal field countries now possess. There will then be hot strife for hot territory, and the alcohol power will rule the world. Dr. Diesel, believing that his engine using heavy oils—mineral or vegetable—would take the place of the gasoline engines burning light fluids like gasoline or alcohol, foresaw the time when palm, peanut or some other tropical oil would be the motive power on which civilization would depend.

There are, of course, many other conceivable possibilities. We may distill cellulose directly instead of converting it into sugar and then fermenting it to alcohol. The chemist may get up some carbon chain or ring with all the hydrogen it can hold, that will make a better fuel than anything found in nature, but he will have to have something to make it out of and that something will have to be grown. Unless we find some other source of power than combustion, we must eventually grow our fuel as we use it, for fossil fuel will not last forever. We must find a way of using the sunshine of today instead of that which fell upon the earth in the carboniferous era.—Abstract from the *Scientific Monthly* for August, 1922.

The Scumming or Weathering of Glass in Storage

THE conditions under which glass is stored have a pronounced effect upon the appearance of the glass. For some time the Bureau of Standards has been studying this problem, and during the past month several hundred bottles, which have been in storage six months under different conditions of storage and packing, were examined.

The results show quite definitely the better condition of ware stored in a dry place with an even temperature as compared with outdoor conditions or a very humid room, the latter being much more productive of scummed bottles. Bottles packed in thin fiber board boxes were in better condition than those packed in open crates, while bottles wrapped tightly in paper were in worse condition than those not wrapped. Cork or paper stoppers did not assist greatly in reducing the amount of weathering, but rubber stoppers nearly eliminated it. Dust seemed to accelerate the trouble. Samples stored in factory warehouses and at Panama are still to be investigated.

Master Builders Called Insects

Works of Home-Building Insects and the Part Played by Their Raw Material Called Sericin

By S. F. Aaron

AMONG the house and nest building creatures, the cocoon makers have proved themselves the master builders. Endowed by nature with the material and the tools, these handy and provident animals of the six-legged fraternity have developed the highest constructive and adaptive skill next to that of man and very closely akin to some of his better efforts.

Of the home-building insects we have paper makers, potters, carpenters, stone masons, weavers, bridge builders, assemblers, inlayers, felters, stitchers, and riggers. By carefully going over the field some other "trades" might be added that are more specific.

Strand of silk as exuded by the cultivated worm, and sections of silk, showing the adhering and binding sericin. Greatly magnified

The silk worm's handiwork

Man's constructive results depend on his gathering all of the materials with which he works, and then combining them. The insect artisans are endowed with their main raw product within themselves, and there remains but for them to form up and put together either this material alone, or to combine it with gathered materials.

This essential raw product has been called sericin. It is secreted in the insect, or spider body organism, and it hardly differs chemically from the chitine of which the insect outer crust is composed and which exists throughout the muscles and inner organism. Exuded in liquid form which quickly hardens in contact with the air, the sericin is the substance of which silk is composed and also the most perfect cement employed by many species of Hexipods of certain orders to hold together the gathered materials used in nest and cell building. It even forms an essential though small portion of the wax comb of the honey bee.

In all of the insects, whether caterpillar, grub, or adult, the sericin is exuded and drawn from the mouth after secretion in salivary glands behind the head, or what are known as the prothoracic segments. In the silk worms of many species, wild and domesticated, as well as other caterpillars of moths, these glands are very large, as may be indicated by the amount of silk and adhesive material in their cocoons; but with all species that have need of sericin, there seems to be a plentiful supply, whether in bee, wasp, beetle or moth.

The spiders secrete the sericin in the abdomen and it is exuded through spinnerets, several strands making a thread; they also seem to have an inexhaustible amount.

Silk is the almost indefinitely drawn out threads of this salivaceous material hardening as quickly as it is exposed to the air into a tough, flexible, smooth, rounded or somewhat flattened thread or cable, each strand made up of two or more threads, adhering because of the roughened, gummy material surrounding it, and which first was given the name of sericin. Of these strands all Lepidopterous cocoons are made and also those of certain species of the Hymenoptera, as well as those of the tiny parasite wasps known as Apenteles and Mocrogaster, which infest the caterpillars of many moths, and emerging build cocoons that closely resemble in miniature, being not more than an eighth of an inch long, the cocoons of the cultivated silk worm, in shape, texture and color.

Cocoons of many moth larvæ, especially those of the tropics, are not only densely overlaid with silken strands, but they are so impregnated with the gummy mass of non-thread sericin as to seem composed of that alone and becoming so thick and hard and yet nonbrittle as to resemble greatly compressed papier-mache more than anything else. So hard, tough and strong are they as to be impervious to the drills of the larger ichneumon flies, which can penetrate the hardest woods, and to withstand the crushing effect of parrots' bills capable of easily cracking Brazil nuts.

The purpose of all cocoons, or the cells of other materials built around them, is to defeat bird, mouse and insect enemies, the latter mostly parasite; they in no way protect the inmates against cold and they are thicker and more impervious to weather conditions in the tropics than within the arctic circle.

The caterpillars of the diurnal Lepidoptera, (butterflies), seem to have small use for sericin, either as a silk, or cement. Some of the skipper butterflies, known as Hesperides, make flimsy cocoons or with silken strands tie leaves together as a protecting nest for the chrysalis, as do also certain moths. Many species spin a single loop of silk to support the body of the chrysalis, and a matted mass of sericin attached to the posterior end also as a support. Certain swallowtails also (Papilio) spin a thin mass of threads on the surface of leaves to which the caterpillar clings while molting.

The cocoons of the Hymenoptera of nearly all species are generally quite dissimilar to those of the nocturnal Lepidoptera, in that they are always within cells of other materials, seeming to possess no other purpose than that of a softly confining envelope to imprison the delicate larva and pupa during its transformations, and they are of a character resembling parchment, though with an outer floss of looser fibers. In some species, as the mud dauber wasps and allied forms, one end is a darker, hard mass the purpose of which is not obvious.

Earthen jug of potter wasp broken open to show parchment-like silken cocoon within. Sericin is employed also to hold the sand of the thin walls of the jug together. Somewhat magnified

The potter wasp's jug

Through a microscope or powerful magnifying glass, fine threads as delicate as those of the spider are seen to compose these skin-like cocoons, the strands are matted together with such short turns as to give the appearance of a felting of short pieces, though they are actually continuous. They adhere by a superabundance of gummy sericin that gives the inner lining of the cocoon a varnished appearance and of a similar yellowish-brown color, the whole being exceedingly thin and smooth and yet comparatively tough. A similar coating of dark sericin forming a varnished inner surface, is seen in many cocoons of the cultivated silk worm and other allied wild species; it is indeed the rule with certain forms and adds strength and finish to the inner chamber.

Larval and pupal cases of the caddis-fly worm. The pebbles and sticks are held together by gummy sericin and are lined with silken fibers of the same material. Magnified

Products of the caddis-fly worm

We see cocoons of this character also in the underground burrows of the digger wasps. The pupæ of ants all surround themselves with similar skin-like cocoons and so do all of the larger parasitic wasps, these often being enveloped by the dried, eaten-out shells of the host caterpillars. Certain bees also, as the digging and wood-boring, green-bodied Andrenids and the solitary carpenter bees and hornets, as well as the social paper nest wasps, employ their abundantly secreted larval sericin in like manner.

But it is the use of sericin as a cementing material by adult nestbuilding insects that most interestingly attracts our attention, as from a parallel in human utility. These species are never cocoon builders; no adult insects build cocoons for their larvæ, but instead, nests in which the larvæ surround themselves with cocoons. These nests are always made of gathered materials, such as paper, sand, pebbles, leaves and sticks, and are held together by the rather liberally exuded sericin.

After watching the mud dauber wasp gathering clay beside the stream, take some of the same wet earth in your fingers and try to form it into a mass that will stick together and harden firmly, adhering also to any surface. Your effort will be a failure and the secret of the wasp's success is in mixing the sand with sericin, thus making a cement which withstands the elements.

Cultivated silk worm cocoon in comparison with cocoons of parasitic wasps. Note the hinged cover end of the cocoons of the parasitic wasps. Slightly magnified

Cocoons of silk worm and wasps

Observe a paper nest wasp at work gathering wood fiber. With the most delicate manipulation of finger nail or knife point select similar woody fibers from dead limb or fence rail and try to mat them into paper with no more force than the wasp can give. But you will not succeed. Then subject a bit of the wasp's paper taken from a nest to the action of warm water, as employed to soften cocoons for reeling off the silk, and watch the fibers fall apart. Close observation of the wasp at nest building will disclose the mixing of the gathered fibers with saliva, and this is sericin.

The larvæ of wood-bearing beetles that plug themselves in, against enemy attack, by a wall or wad of powder post or jaw dust across the burrow, also use a small amount of sericin, probably possessing little.

The most remarkable use which the insects make of their secreted sericin is in the cases made under water by the larvæ of the caddis flies. These cases, in which pebbles, grains of sand, etc., are cemented together in various forms, have always excited wonder, because of their remarkable resemblance to the shells of fresh snails, larger bits of stone and certain aquatic plant seeds. For a long time there was much controversy as to the means employed by these artistic insects to hold together these bits of hard material under water, but the method was easily recognized by the writer after observing the insects work in aquaria. Subjecting the larvæ cases to the action of warm water furnished further proof of the use of sericin.

If we could determine the exact character of sericin well enough to learn how to make it, we should at last possess a truly waterproof and durable glue of superior adhesiveness. It would be noninflammable and as transparent in thin sheets as celluloid, with probably as much flexibility. Sericin is not entirely of vegetable origin, for some of the creatures that possess it in quantity, as spiders and wasps, are strictly carnivorous. However, this fact may not even offer a clue toward its precise composition.

Measurements of Electron Tubes and Amplifiers

FOR a number of years the Bureau of Standards has been measuring the various properties of electron tubes and the voltage amplification of amplifiers. The apparatus and methods used for these measurements have been changed and improved as the properties of the tubes have become better known. Descriptions of the apparatus and methods now used at the Bureau are given in Letter Circular 86 "Methods of Measuring Voltage Amplification of Amplifiers" and Letter Circular 87 "Methods of Measuring Properties of Electron Tubes."

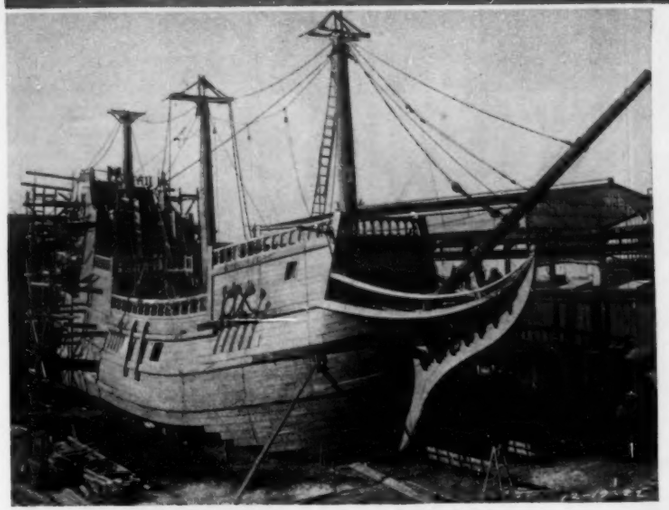
Letter Circular 86 describes in detail methods for measuring the voltage amplification of both audio frequency and radio frequency amplifiers, outlines precautions to be observed and gives circuit diagrams.

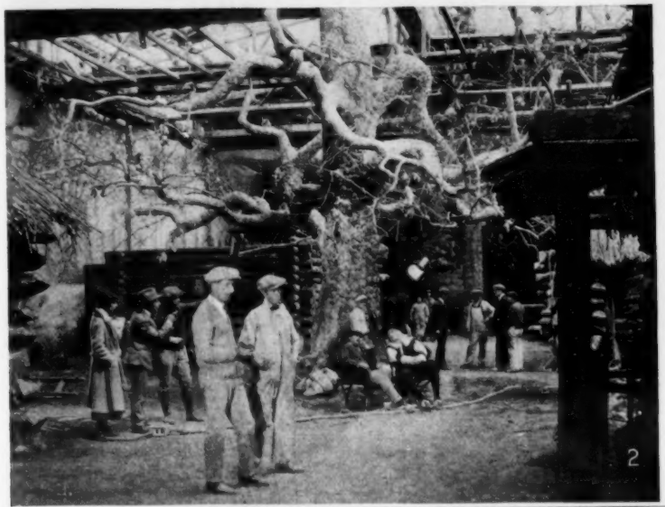
Letter Circular 87 describes in detail methods for measuring internal input resistance, internal output resistance, and the amplification coefficient of an electron tube using a combination alternating current bridge. It also describes methods for measuring the direct current characteristics of a tube and the power output of generator tubes, as well as the measurement of detection factor. Precautions which should be observed in making the various measurements as well as circuit diagrams are included.

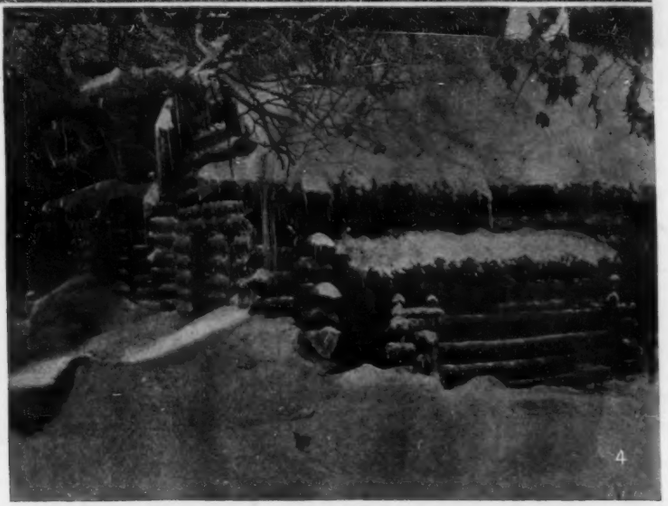
A limited supply of these letter circulars is available at the Bureau, and while the supply lasts copies will be sent to any person who can show an actual need for the same.

The Bureau of Standards, having an entire laboratory set aside for radio work, has been largely instrumental in the rapid progress of radio development. The Bureau has published numerous technical papers of great value to the radio fraternity in general.

PILGRIMS IN MAKE-BELIEVE LAND







1. The make-believe "Mayflower" in the course of construction. True to motion picture tradition, only those parts which come within the camera's critical eye have been finished in great detail. 2. A bit of old Plymouth reproduced under the glass roof of the studio. 3. Stern of the make-believe "Mayflower," surrounded by water but not floating in the water. In fact, the ship is a terra firma craft to begin with, mounted on a pivot so that it could be rocked. The water is merely placed about the ship, for realistic effect. 4. A Pilgrim log cabin in appearance, but a motion picture "set" in reality, with marble dust to simulate snow. 5. The cause of the pitching and tossing of the make-believe "Mayflower." Here is the concrete pier and pivot supporting the frame which carries the replica, as well as part of the steam engine plant which supplies the rocking motion

WITH that intense zealousness for realistic effects which is characteristic of leading photoplay producers, a Hollywood studio has recently made a new record in vividness of motion picture effects by building and "sailing" a replica of the famous "Mayflower" on land, by artificially creating awe-inspiring ocean storms in a great indoor studio, and by reconstructing a large part of the pilgrim village of Plymouth under a giant glass roof.

The quaint sailing vessel which brought its devout passengers to America has been produced at a cost of $60,000, the size and external appearance from every angle being exactly the same as the original. The costly "set" was mounted on a rectangular structural steel frame 90 feet long, and this in turn was delicately balanced on a single concrete pier so that the ship could be made to roll and toss in realistic fashion. This characteristic movement of a craft on a rolling sea was produced by means of two steam engines connected with eccentrically mounted controls. One engine caused the ship to roll from side to side, while the other caused the ship to rise and pitch. Bumpers, consisting of two huge coil springs under the ends and sides of the frame, were provided to aid in the rebound of the vessel.

In order that the "Mayflower" might appear to be actually riding the waves, a concrete tank covering an acre of ground was built around the vessel and filled with water. The latter was agitated by hidden mechanical means to produce high waves about the ship.

While the photoplay "Mayflower" was complete in every external detail and so carefully finished that it could be photographed from any point, each of the decks where close-ups of intense action were made, were reproduced indoors. There were three of these decks, and each of them, like the ship itself, was mounted on a pivoted steel frame so that it could be made to heave, toss and roll. The reason for the reproduction of these decks as separate units lay in the fact that the scenario of this photoplay called for a terrific storm at sea. Around the edge of each deck and some ten feet above it, so as to be out of the camera's range, were built huge tanks with trap door ends. These tanks held from five to ten tons of water and their entire contents could be emptied instantly on the decks merely by pulling a releasing rope.

In the course of the play hundreds of tons of water were hurled on these decks while the actors, not only simulating exhaustion but actually experiencing it, fought their way from side to side as the "waves" broke over them. The acting was made at once more difficult and realistic by the use of wind machines which drove the spray across the decks in true nor'-wester fashion. For the purpose of representing hail, several bushels of moth balls were blown against the actors and decks with a second wind machine. These little white spheres photographed splendidly, but made many an actor black and blue on exposed parts of his body.

Equally remarkable were the snow scenes produced both on the deck of the large ship itself and in the village of Plymouth. The effect of snow was produced by the use of marble dust which keeps its shape much like snow and does not fill the air with dust when disturbed—an important consideration both for the actors and for the cameraman and their ever-watchful cameras.

Budding

The Process by Which Nurserymen and Fruit Growers Produce Our Best Fruits

By Dr. E. Bade

GRAFTING is a method of propagating trees wherein the variety of stock desired is produced by joining to a tree of wild stock at a point above the ground, a fruit-potential part of a tree which is already known to have been bearing good fruit. It is primarily made necessary for the reason that fruit grown directly from seeds is almost worthless. All of our best varieties of fruit have been developed by careful artificial selection from the most promising of primitive stocks, and the good characteristics are carried forward from generation to generation of trees, not by growing young trees from seeds such as pits and appleseeds, but by some form of grafting. If the best tree which has been produced by grafting, or budding of, say, a hundred trees is used as a source of scions, then there should be a step upward in the quality of the average fruit. Such a process, carried along during many years, has produced our superb varieties of apples from the wild crabapple, which as a fruit is comparatively undesirable. But if the seeds from such an improved apple are planted, and the seedlings are allowed to grow up and produce their own fruit, the latter will revert to the original type. So powerful, then, are primitive instincts in the world of life. For these reasons it is necessary to produce our orchard fruit by grafting, and it is found that the fruit takes its characteristics, not from the stock of the wild tree from which it gets its life and plant food, but from the branches developed out of the tiny scion. Illogical as this may seem, it is nevertheless the case. This process of propagating a desirable stock on the tree of an undesirable stock is by no means new, for knowledge of it came down to us from the early Semitics, through the Greeks and Romans.

Grafting is successful only when it is possible to make the stock and the scion unite, and this as a rule is only possible when the species chosen are of the same or closely related species. In this case the bark and the wood have similar characteristics, a microscopical examination showing that their qualities are closely similar. There must be an intimate union between related cells. Graftings of unrelated species generally live only a short time. Such unusual unions, however, when they are successful, are exceedingly interesting. It is a proved fact that every grafted plant, when left to itself will revert to its former wild state, throwing off every characteristic man has forced upon it throughout generations of careful and selective propagation.

In the process of grafting, a scion from a well cultivated fruit or flowering tree which has especially desirable characteristics is cut and placed upon some wild stock or other and is treated in such a manner that the scion receives all the nourishment and strength. All the shoots that develop from the stock itself are suppressed, while those developed from the scion are favored in every way. This finally produces the grafted plant.

In practice, grafting is carried out in various ways, two most important of which are grafting proper in its many forms, and budding, which is really a kind of grafting.

Altogether the most common artificial method of propagation is that of budding. It is the easiest to perform, makes only a small wound in the bark of the tree and therefore does not hinder its growth appreciably. It is the most economical form of artificial reproduction, a great quantity of stock being readily obtainable because each twig of the desired species has numerous buds.

The most favorable time for budding is when the sap has accumulated between bark and wood, so that the bark can easily be loosened. This occurs both in the spring and in the fall. Budding in the spring, since it forms a new twig the same year, is termed budding upon the growing bud, while the process, if done in August or September, is called budding on the resting bud. In the latter case the scion remains on the stock until the spring, and begins at that time to form its shoots.

The time of day usually chosen for this interesting operation is either in the early morning or late afternoon. A cool, cloudless day is best, and since rainy weather has an unfavorable influence upon the buds, the moisture diluting the sticky, gelatinous sap of the bud and stock, it should preferably follow immediately on the heels of a rainy spell, when there is good probability of a few days of dry weather. The buds should be taken from the sunny side of a good bearing tree, choosing the large, vigorous buds found in the center of the scion twig.

When budding is to be carried out in the fall, part of the petiole of the leaf is left on the bud, and this is cut out in such a manner that no wood remains attached to it. This petiole serves as a handle to facilitate the introduction of the bark to the bud beneath the bark of the stock. One should never touch the smooth, shiny bark on the back of the bud, for this may prevent a union being made between the respective cells of the parts to be grafted. Before the bud is cut from the scion, a T-shaped cut is made in the bark of the stock, care being taken not to cut too deeply, for if the wood itself is cut the wound will heal very slowly. The stock at the point of budding should be at least as large as an ordinary lead pencil. Such a thickness is attained by both apple and pear trees in the second year of the stock or seedling. But the peach tree reaches the same thickness in the first year, so that budding may be done late in the fall and thus on stock less than one year old. Rose stock, however, cannot be used before the third year.

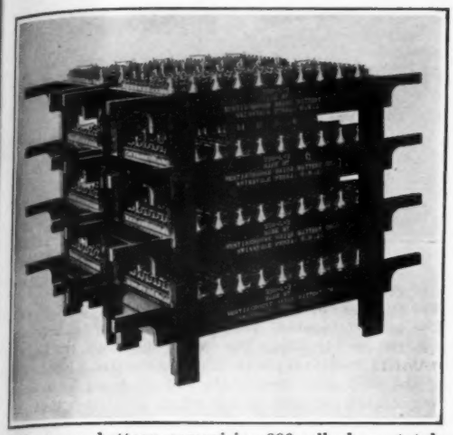
The bud is removed from the scion twig with an oval shield left surrounding it, using a sharp small knife blade. It does no particular harm if a small strip of wood remains attached to the bark, but under no condition should a large fragment of it remain. The most important thing to be remembered is that the vascular bundles leading to the bud must remain uninjured. These may be found as a slight protuberance just beneath the bark. When prepared, the bud is inserted into the cut or slit of the stock. In this process the two flaps are bent slightly backwards with the knife, the bud is grasped by the petiole and is gently slipped into the cut. The flaps are then carefully pressed down on the bud, and a ligature is drawn around the stock both above and below it to hold it in place until it begins to grow. Care must be taken not to cover the bud itself with the binding material, and if raffia is used it should be first moistened with water. Wool and cotton strings may be used if desired. The method used in winding and tying is unimportant as long as a neat job is done. Whenever raffia is used it should be smeared with grafting wax so that no larvae of insects can reach the wound.

After budding, the shoots of the stock are slightly cut back, and after a year's growth, or in the spring, they are cut back entirely until nothing remains but the grafted stock which is later to become the tree. About three or four weeks after budding, the ligature should be loosened so that the sap may flow uniformly and no constrictions may be brought about as the bud grows. The successfulness of the graft may be tested by gently testing the petiole of the bud. If it falls off at the slightest touch, or if it has already fallen off of its own accord, the bud is thereby shown to have formed a union with the stock. But if the petiole is shrivelled and dried up, the bud is dead.

If the bud has been grafted in the fall it should not be permitted to form shoots. If, in spite of such precautions, a shoot is formed, this must be permitted to grow. But the shoot, after it has finished its growth, is cut back to one bud. That is to say, the stock is cut back in proportion to the lateness of the season in which it was budded. When budding is commenced relatively early, no shoots are cut off, but when it is commenced late, they are nearly all trimmed away.

Left: Cutting the bud from the scion. A shield-shaped portion of the bark of the bud twig is left at the base of the bud. *Center:* Inserting the bud beneath the already incised T-shaped cut in the stock. This is a process requiring care, yet it may be done very quickly. *Right:* The flaps are folded over the bud and the latter is held in place by means of a wrapping of raffia until a natural union has taken place between the two parts. After the bud has united with the stock, and made a reasonable growth, the main stem of the stock is cut off just above the bud and the latter becomes in time the fruit-bearing part of the tree

The simple process of budding which enables fine fruit to be grown on scrub trees



This storage battery, comprising 880 cells, has a total voltage of 1760 and a watt-hour capacity of 7000 watts with one-half ampere discharge rate

Combining High Voltage with Compactness in Storage Battery Construction

AN unusually high voltage coupled with compactness and flexibility has been attained in a storage battery supplied by an American manufacturer to the Navy Department for the Bureau of Standards at Washington. While by no means the largest storage battery ever made, it is probably as high a voltage storage battery as has ever been put to practical use, and undoubtedly the highest voltage lead storage battery which has been used in radio service. It is for the Bureau of Standards' radio laboratory, where a wide variation of voltage is essential to the testing of various types of radio apparatus.

The difficulty ordinarily experienced with high voltage storage batteries is to make them sufficiently compact. The danger of leakage and discharge has been another problem. These difficulties have been overcome, and at the same time the Government's requirements of a portable battery which would deliver either a total high voltage or any desired low discharge, have been met.

While the battery has a total voltage of 1760 volts, it is interesting to note that the eight-hour rate in amperes is only one-half ampere. The watt-hour capacity is 7000 watts. Each cell consists of a pressed glass jar 1 7/16 inches long by 3 7/16 inches wide by 4¼ inches high. The plates are 2½ inches square, with a thickness of 3/16 inch. A hard-rubber cover is sealed to the top of each jar, the covers being equipped with threaded screws and vent plugs so that distilled water can be added when necessary and hydrometer readings taken.

The cells are assembled in series of 11 in hard-wood boxes 17⅛ inches long, 3 13/16 inches wide, and 3 11/16 inches high. The series connection is made by means of lugs extending through the covers of the cells, each one being welded to the adjoining plate lug of the opposite polarity. Each of these batteries of 11 cells has a voltage of 22 volts. Ten batteries of this size occupy each of eight large wooden trays, giving each tray a tension of 220 volts. The whole comprises 880 jars.

Each battery is held in place in its tray by wood screws. In case of accident or breakage of any of the batteries or any individual cell, the battery affected can be removed and replaced without interfering with the remainder of the tray.

Inter-battery connections are by means of short rubber-covered cables having lugs attached to their ends. These are held in place by lead-covered brass nuts. These inter-cell connections are easily removed, so that approximately any fraction of the total voltage can be obtained. The batteries may also be divided into small groups and charged in multiple in case high charging voltage is not available.

The weight of a single tray, consisting of ten series of cells, is 250 pounds. There are eight of these trays, making the total weight of the battery 2000 pounds.

Small plugs made from waste wood and used to plug the holes left in ties after pulling the steel spikes

A Machine That Pounds Concrete Roads to Pieces

ENGLAND, famed for its excellent highways, has not been slow to adopt labor-saving machinery, even if labor is plentiful in England at present. An instance of the excellent labor-saving equipment now being used in the building and rebuilding of English roads is presented in the accompanying view, showing a huge concrete-road breaker. Here is a powerful machine, weighing 20 tons, which travels over concrete roads and pounds them to pieces, in order that a new road surface may be laid. This machine is provided with four pairs of chisels which are pounded in due turn on the concrete surface under the action of the cams on the driving shaft. A gasoline engine supplies the necessary power. The machine travels along at a slow rate of speed, smashing the concrete pavement behind it.

Using Wood Waste to Halt Decay

WHEN a commercial organization goes to the trouble of finding a use for bits of waste wood scarcely larger than a man's finger, a hasty judgment might condemn the practice as "picayunish." Prejudice against such careful utilization is, however, not always justified. The cutting of the boxful of wooden pegs shown in the photograph above, is the result of an effort in wood saving entirely consistent with the diminishing supply and rising price of forest products.

The remarkable thing about these pegs is the fact that they are to be used only to increase the usefulness of larger pieces of wood.

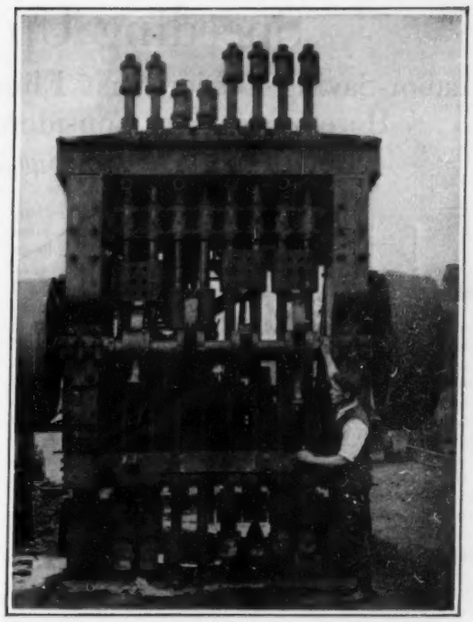
A manufacturing corporation, managing a forest to supply its wood needs, uses them to plug the holes left in ties after pulling the steel spikes, in cases where spikes must be pulled and redriven. As the plug keeps out the moisture and retards the progress of decay in the old spike hole, a longer period of service is secured from the tie after replacement, than would be possible were infection unhindered at this point.

The corporation mentioned, in producing small dimension stock for the manufacture of its product, saws the material direct from the log. In this way the high wastage incident to cutting dimension stock from lumber of standard sizes, is avoided. The final operation, the cutting of the pegs shown here, from the trim of the dimension stock, reduces the percentage of waste to a minimum.

Oil-Cooling the Motorcycle Engine

THE designer of the engine which forms the subject of this article claims that in any water-cooled engine 80 per cent of the cooling is effected by the lubrication system, and the claim appears to be substantiated by the enormous lubricating systems found necessary on racing cars and on some airplane engines. Then, too, it is interesting to note that in some of the waterless areas of the Near East the British army use oil in the radiators of cars in place of water, and find it acts quite well.

The motorcycle engine shown in the accompanying view is the latest British attempt towards evolving a small, highly efficient engine for motorcycle or automobile use. This little power plant is rated at 3½ horsepower, having a 500-cubic centimeter cylinder capacity. A similar engine with 700 cubic centimeter cylinder capacity, is rated at five horsepower. The actual power delivered at normal speeds considerably exceeds these figures. The larger type is intended for small cars rather than motorcycles.



Rear view of a concrete smasher, weighing 20 tons, employed in British highway repair work

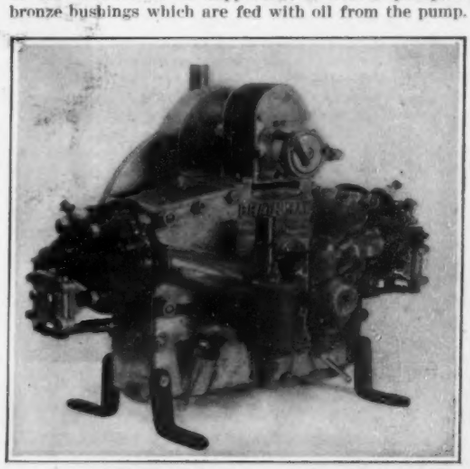
The flywheels in these small engines are outside the crankcase, being placed in front of the engine and having vanes to act in part as a cooling fan.

In the engine illustrated the valve rocker arms are clearly seen, but it will also be observed that the bearing surfaces are enclosed in a little aluminum box which is an oil reservoir from which the rocker bearings are fed by wick feed. In the larger engine, however, the whole mechanism is enclosed.

The level of the oil in the crankcase is kept some 1½ inches from the bottom. A gear pump driven from the cam-shaft is used to draw the oil from the pump through a gauze filter and to deliver it under pressure to the internally drilled crankshaft.

The oil release grooves in the crankshaft serve to fling the oil around. After the oil has become heated in contact with the working parts, it falls back into the sump. The outside of the crankcase is used as a radiating surface to dissipate the heat imparted by the engine to the oil. The cylinders are perfectly symmetrical and the oil mist reaches the outside as well as the inside.

On the flywheel side of the engine, the crankshaft is supported on double journal ball-bearings, the space between being occupied by the cam-shaft gear drive and timing wheels for the magneto drive. The other end of the crankshaft is supported in double phosphor bronze bushings which are fed with oil from the pump.



Small 3½-horsepower engine of the oil-cooled type, especially intended for motorcycles

Speeding Up Track Work

Labor-Saving Devices that Eliminate the Drudgery Which Has Heretofore Been Considered Inherent to Railroading

By Milburn Moore

IN LAYING new rail on the railroads, one of the problems which it has been most difficult to overcome has been that of keeping the men steadily at work. The task of removing the old rail from the track and setting in the new has always been extremely laborious and this condition has continued to grow worse in late years as a result of the increased weight of rail. Other tasks as, for instance, the drilling of bond-wire holes have also been not only fatiguing but monotonous as well. It has not been unusual to have men leave the work at different periods of the day because of these features. In the days preceding the war, when labor was both abundant and cheap, this was not such a serious item. Today it is serious, for although labor is plentiful at the time of this writing, it is by no means cheap so far as the railways are concerned, and all indications are that the present abundant supply is only more or less of a temporary situation.

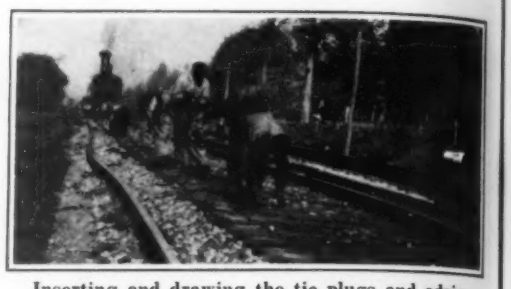
In an effort to reduce the labor necessary in laying rail and at the same time to eliminate the drudgery which has been considered as practically inherent in the work, the Lehigh Valley Railroad developed a plan whereby it can perform the work at least equally well through the use of modern machinery and mechanical appliances. Locomotive cranes are utilized for handling both the old and the new steel, while portable air-compressors and air drills have been adapted to drilling the bond-wire holes. This method has been augmented by the experimental use of pneumatic wrenches for running up and tightening the nuts on the six-bolt joints that this road installs. As a result the men have done better work, a smaller number have been used and there has been no necessity for relieving the men on account of the character of the work. The rail which is handled has a 130-pound section, *i. e.*, it weighs 130 pounds to the yard, and through the utilization of locomotive cranes as many as 159 rails of this weight have been laid in an hour, while daily average rates of from 80 to 110 rails per hour have been maintained regularly.

Aside from the points brought out in the above, the remaining important feature of the plan is that the old track is in service up to the minute work is begun and that by the time the forces have passed over it, the new track is completely finished and ready for service again. Since mechanical equipment is used for laying the rail, it is necessary that the track be given over to the forces free from any possible interruptions by traffic movements. On a double track road such as the Lehigh Valley, this means that the section to be relaid must be operated as a single track line.

In actual operation all arrangements in regard to assembling the forces and distributing the material in the proper amount and at the proper location, are made beforehand, after which the track is taken over at a predetermined hour in the morning. The mechanical equipment is moved into place ready to start and the main track upon which rail is to be laid, is then cut and the ends swung over and connected up with the second main track, provided there are no switches or crossovers already in place. A trainmaster or some specially instructed assistant immediately takes charge of the movement of trains over the now single track section, working in conjunction with the train dispatcher, with whom he keeps in close touch by means of field telephones. In this operation a pilot engine is used, trains from either direction being permitted to enter the single track section only from the end at which the pilot engine is stationed. A large part of the force is next started pulling spikes on one line of the old rail, throwing it out, removing the tie plates, adzing the ties and placing a few new tie plates in order that the crane can begin work with the least possible delay. With the laying of rail once under way, the organization is broken up into a number of smaller units consisting of from one to thirty or more men, to each of which is assigned a definite task. The force gradually strings itself out over the line of the track sometimes for as much as one-half mile in length, and represents a continuous succession of progressive stages of work. The track ahead of the men is untouched; behind the men the new rail is in place, fully tie-plated, spiked, bolted, bonded for signal circuits and ready for operation.

Repeated laying of rail has demonstrated that a force of about 200 men is required to keep a locomotive crane working to its full capacity, although a smaller number than this is often used. The number of men to each individual gang is assigned in proportion to the entire number at work and with each unit given a definite task, there has resulted but little or no waste time or lost motion.

The first gang usually consists of a few men who set up the new rail on its base, mark the exact center by a chalk line across the head, and break joints in the old rail on curves at intervals of about ten rail lengths. These men are followed by a gang who pull the spikes on one rail only, *i. e.*, on one line, after which this freed rail is thrown out by a following unit. As soon as the track is thus cleared of the old rail, the tie plates are picked up, thrown clear of the track, and creosoted tie plugs are distributed, inserted and driven well down into the spike holes. After this has been done, the projecting ends of the tie plugs are cut off and wherever it is necessary the ties are adzed level and smooth. The new tie plates, which have previously been distributed evenly along the center between tracks, are then laid in the proper position on the ties. Each stage of the work described above is performed by a single unit of the original organization, and each unit performs nothing but the task assigned to it.

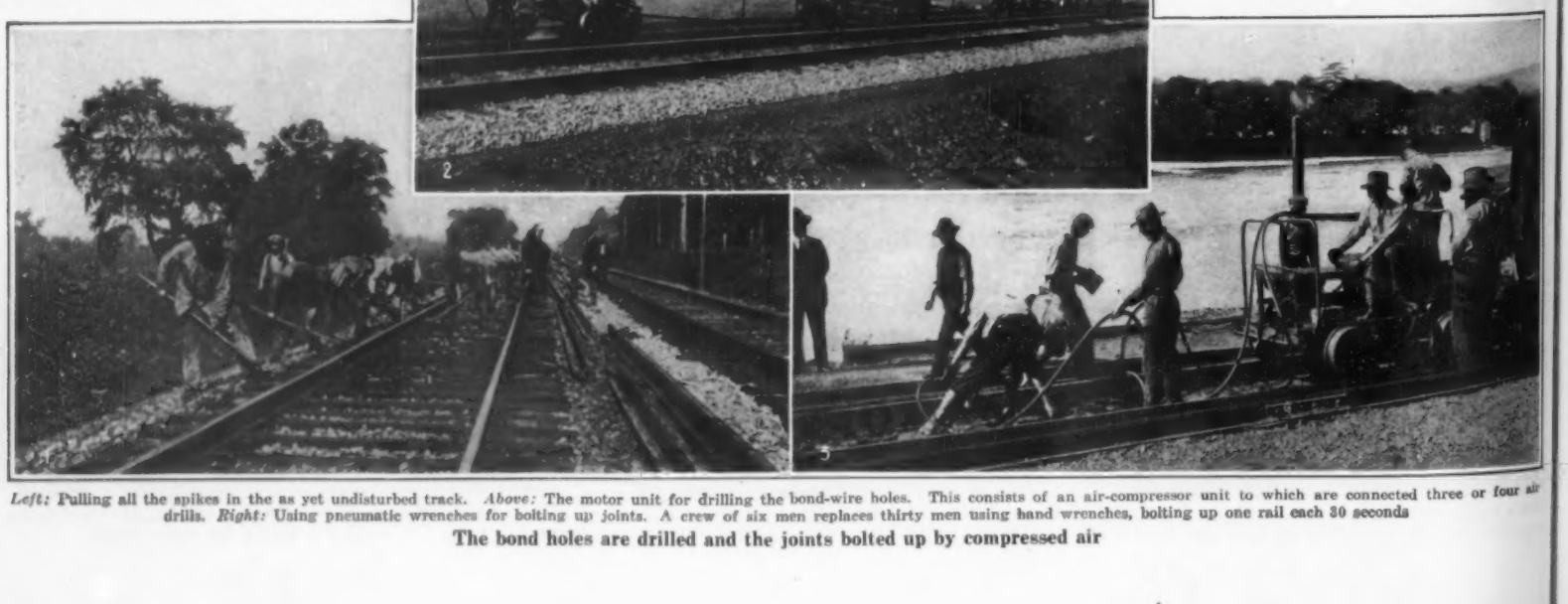


Inserting and drawing the tie plugs and adzing the ties

This brings the work to where the first crane is used. In laying rail with a locomotive crane, two spikes are driven partly down into the ties in such a position as to bring the ends of the new rail to the correct gage. At the same time the boom of the crane is swung over and the hoisting cable hooked onto the new rail at its exact center, as indicated by the chalk-mark. One man is assigned to the duty of taking care of the hook and usually this is the foreman of the crane forces. The rail, as it is picked up and swung over, is steadied in its movement by two men at each end, who also guide it against the two spikes mentioned and the end of the previously laid rail. A proper allowance for expansion is obtained by inserting a shim which is withdrawn as soon as the rail has been seated. Men with lining bars then hold the newly-laid length of rail tightly against the two end spikes while two additional ones are driven in on the opposite side. A small chip of wood is placed over the abutting ends of the rail, in order to prevent the rail from being crowded ahead by the wheels of the crane. The crane is now moved forward one rail length where the operation is repeated. With the work going well, all of these operations are carried on simultaneously. In actual practice, rail is laid by the crane forces at the rate of a length in every twenty-five to forty seconds. The crane organization is followed by men who bar the center of the rail to gage, and spike it down at that point.

In laying rail with locomotive cranes, one or more cranes may be used as desired, provided there are sufficient men available. Where one crane is used, only one line of rail is relaid at a time and when this operation is completed the organization returns to the start and repeats the operation on the second line. Where two cranes or multiples of two are used, the work is completed on the first trip over the track and takes the form described in this article, although up to the point covered so far the work is precisely the same for any number. With the passing of the first crane and the gaging of the rail at its center, a number of units of men corresponding almost exactly to the organization preceding the first crane follow along after, loosening up the rail and throwing it out in the manner described. The sec-

(*Continued on page 429*)



Left: Pulling all the spikes in the as yet undisturbed track. *Above:* The motor unit for drilling the bond-wire holes. This consists of an air-compressor unit to which are connected three or four air drills. *Right:* Using pneumatic wrenches for bolting up joints. A crew of six men replaces thirty men using hand wrenches, bolting up one rail each 30 seconds

The bond holes are drilled and the joints bolted up by compressed air

Timing an Ice Sheet

EVER since Louis Agassiz conceived the idea of former continental ice sheets over northern Europe and North America, geologists of two continents have been gathering evidences of them. New England, the home of Agassiz almost from the time when his glacial theory was announced until his death, presents varied and plentiful proof of glaciation.

The American Geographical Society has just published a monograph entitled "The Recession of the Last Ice Sheet in New England," by Dr. Ernst Antevs of the University of Stockholm, which presents something that is new and, if we can use such a term in relation to geology, spectacular.

In all history a knowledge of exact time is vital. Chronology is the thread on which events are tied like pearls on a string. The history of the earth was a history without absolute time, without dates, until Gerard De Geer, forty years ago, found a way which enabled him and Ragnar Lidén to work out a chronology of the last 13,500 years. De Geer's and Lidén's time scale has the year as its unit, and is exact. It is based on annual layers in clay and silt—"varves," very much resembling annual rings of trees. The clay was deposited in lakes in front of the receding edge of the ice sheet, and in fiords in northern Sweden after the ice had disappeared. Except for the last few hundred years, this time scale comprises the whole time since the land ice uncovered southernmost Sweden. The retreat of the ice from southern Sweden to Ragunda, 270 miles north-northwest of Stockholm, took about 5000 years; and the time that has elapsed since then is found by Lidén to be about 8500 years. Accordingly, the uncovering of southernmost Sweden began about 13,500 years ago.

The present work is based upon field work carried on during five and a half months and chiefly comprises investigations in the Connecticut Valley from Hartford, Conn., to St. Johnsbury, Vt., and in the Merrimac Valley around Concord, N. H. Field work lasting two months was carried on during the same season in the Hudson and Champlain Valleys and north of St. Johnsbury, but little use is made here of the material collected outside New England. While a chronology of the ice retreat from Hartford to St. Johnsbury has been obtained, this is not connected with present time; and so the question, How long ago? cannot be answered.

In Europe the development of the new methods by De Geer and his associates has already indicated the possibility (a) of determining an exact time scale of late glacial and post-glacial time, (b) of reconstructing the position of the ice border more or less accurately during each year of its withdrawal, (c) of measuring the rate of its recession, in meters per year, (d) of detecting halts or zones of retarded recession even where these are not registered by recessional moraines, (e) of working out the complicated changes of drainage that took place as ponded waters were released and modern river systems inaugurated, and even (f) of computing with accuracy the rate of regional uplift of the region during the departure of the ice sheet. In short, De Geer and his colleagues have made great progress in the working out of a detailed history of the retirement of the border of the last land ice from northern Europe, of the evolution of climate, and of the migrations of plants, animals and primitive man.

The student of glacial history, particularly in New England and New York, will discover in this study an amazing array of conclusions. Dr. Antevs has traced a series of clay layers which mark approximately 4000 successive years up the Connecticut Valley from Hartford, Conn., to St. Johnsbury, Vt. He has found large parts of the same series duplicated in the Hudson and Merrimac Valleys. He has worked out successive positions of the receding ice border, after only a few months of field work, in a region where two generations of American geologists, baffled by the absence of definite moraines, have realized little or no success. The estimate of time occupied by this recession is a simple arithmetical count, expressed not in centuries but in years. Such accuracy can never be claimed for our computations of time from the Niagara gorge, where large factors are only imperfectly measurable. An investigation so precise in method and execution, and so suggestive, will give fresh impulse to our studies of Pleistocene glaciation. There is scarcely a problem of the history of this curious and interesting period that Dr. Antevs' work does not touch. It suggests, for instance, where we should look for recessional moraines and how moraines at widely separated points should be correlated. It stimulates more thorough study of the records made in flooded valleys and ponded-lakes, with their shifting, complicated outlines, and of the upward and downward warpings of the region which accompanied the withdrawal of the ice sheet. It assigns to each deposit its proper date, which, while not as yet connected with later records so as to permit it to be expressed as so many years "B. C.," is nevertheless as accurately referred to a certain point in the glacial period as dates of human history are referred to the beginning of the Christian era.

It will be seen that while many annual varves may be accurately correlated with each other, if there exists a gap between these correlated varves and modern time, then any attempt to date these varves as of such and such years B. C. amounts to fictitious accuracy.

Taking the "If" Out of Construction

EMPHASIZING the fact that construction is a basic industry similar to agriculture, manufacture, transportation, mining and forestry, and that it can be improved by organization, cooperation and the elimination of wastes, the American Construction Council, with headquarters at Washington, has been formed. Its inception is the first example on the American industrial calendar where a great industry has united all its branches, including manufacturers, labor and the professional elements, in order to raise the standards and efficiency of the industry and to improve the service which it renders to the public. The outstanding purpose of the new organization is to bring together for conference, for betterment of understanding and for common action the architects, engineers, labor contractors and materials manufacturers, as well as the dealers, bankers and insurance men—all the elements connected with the construction of public works, railroads, bridges, irrigation projects and like endeavors.

In the language of the layman, a fundamental purpose of the new construction association is to protect the public. In fact this idea of making the dominant aims of the American Construction Council dovetail so closely with public welfare has been stressed so strongly that the organization has the cordial and hearty backing of Secretary Herbert Hoover and the Department of Commerce. As described in detail in the November, 1920, issue of *Scientific American Monthly*, the Bureau of Standards is making a national study of building codes, with the purpose of standardizing specifications, laying down fundamental construction rules and preventing extravagant duplications. Such investigations have the endorsement and support of the American Construction Council which will campaign to take the "ifs" and "doubts" out of building activities of all descriptions. It is the ambition of the new organization to eliminate all practices which are inimical in any way to public welfare.

Most of us think of construction as signifying the building of houses, office and apartment buildings. However, in its broader sense, construction includes the building of highways and railroads, of hydro-electric power plants, of factory buildings, and of canals and ship traffic channels for irrigation and reclamation works. Briefly, construction must be considered as a generality, as one of the creators of permanent wealth and as a well-defined foundation stone in our civilization. Illustrative of the fact that this is true, it is worthy of note that construction reports and surveys are now as important as crop reports in reflecting the financial prosperity of the country. When construction is limited, our prosperity is in a slump and millions of people are at a low ebb, financially speaking. On the other hand, when construction is at a maximum, prosperity is as plentiful as the daisies in mid-summer.

When one considers that there are more than 35,000,000 farming people in the country, all actively engaged in agriculture, it is not surprising that agriculture leads the basic industries in volume and magnitude. To most of us it is news that so far as yearly volume and money involved are concerned construction is a close second to farming. At this time more than eleven million persons depend for livelihood on construction. Experts estimate that 24 per cent of our annual capital accumulation and in excess of 50 per cent of our national savings are invested in this great line of activity. Furthermore, about 90 per cent of all the iron, copper and zinc and 95 per cent of all the lead produced annually in the United States, are consumed in construction.

According to the organizers of the American Construction Council, there has been, since the war, a marked lack of coordination, of actual understanding and of consideration of the service rendered the general public by the building industry. Even at this writing we are still away behind on construction. According to leading statisticians and construction authorities, the total value of deferred construction at present amounts to more than $10,000,000,000. Not only are we short on dwelling houses but we also are handicapped by inadequate supplies of office buildings, schools, public highways and railroads. Even sewerage, water supply systems and paving are away below the public needs. The general public since several years has lacked confidence in the fairness of building costs. This diffidence about and deferment of essential building operations have complicated conditions to a point where in most cities congestion is severe, rents are unduly high and general living conditions are far from satisfactory.

As fore-runners of the American Construction Council, a number of other cooperative organizations have to a certain degree begun the solution of the multitude of construction problems that have accumulated. The National Federation of Construction Industries, which was continued even after the Armistice, has accomplished commendable results in taking the dust of unsatisfactory results out of the industry. The building riddles in New York, Seattle and Portland (Ore.) have been worked out with considerable success by local construction congresses. The National Board for Jurisdictional Awards, representing labor, contractors, architects and engineers, and the Joint Conferences of Engineers, Architects and Contractors on Estimating and on Standard Contracts have worked on specific conundrums of building and have demonstrated conclusively the need for and the value of cooperative investigations. The majority of the 250 national associations in the building industry have surveyed themselves critically and are more or less familiar with the flaws and defects and the duplication of work which result from lack of proper organization and stabilization. They are anxious to shift the solution of problems to the shoulders of the new national association, the American Construction Council.

One of the most important initial campaigns of the new association will feature the establishment of a code of ethics which will be universally acceptable to the construction industry. A small minority of the operators are not ethical. Their misdeeds unjustly blackeye the entire industry. In discussing this condition recently, Secretary Hoover remarked, "I am convinced that such conditions can never be cured by legislation or by jails. They can be cured by the resolute action of the vast majority of honest men who form the profession, and it has now become vital in the country's interests that this should be undertaken." This statement by Mr. Hoover is really the slogan of the American Construction Council. It plans to rid the building industry of black sheep, underhand methods and questionable construction.

The collection, compilation and interpretation of construction statistics will be another notable work of the American Construction Council. Although limited endeavors along this line have been instituted by other agencies, the results have never been complete or has information been circulated which covered all the facts. Another scheme of the Council will be to establish local building congresses in all cities and centers where they are needed. Right now there is a lamentable shortage of skilled builders and mechanics. The Council hopes to establish a new and efficient apprentice system which will correct such deficiencies. Seasonal employment needs to be studied and surveyed so as to permit of the most efficient utilization of available labor at all times.

On the basis of the organization effected at this time, the American Construction Council consists of ten branches of the construction industry, including architects, engineers, construction labor, general contractors, sub-contractors, materials and equipment manufacturers, materials and equipment dealers; bond, insurance and real estate interests; construction departments of public utilities and the construction departments of Federal, State and municipal governments. Each of these bodies will have equal voting power in the business discussions of the Council. Among the important associations interested actively in the organization work are the American Institute of Architects, the Federated American Engineering Societies, the Building Trades Department of the American Federation of Labor, the Associated General Contractors, the National Federation of Constructional Industries, the National Building Congress, the National Association of Building Exchanges, the Building Trades Employers Association, the National Real Estate Board and a number of private manufacturing enterprises.

The All-Devouring Marine Borer

A Sea-Coast Fight Between Man and Nature, That Has No End

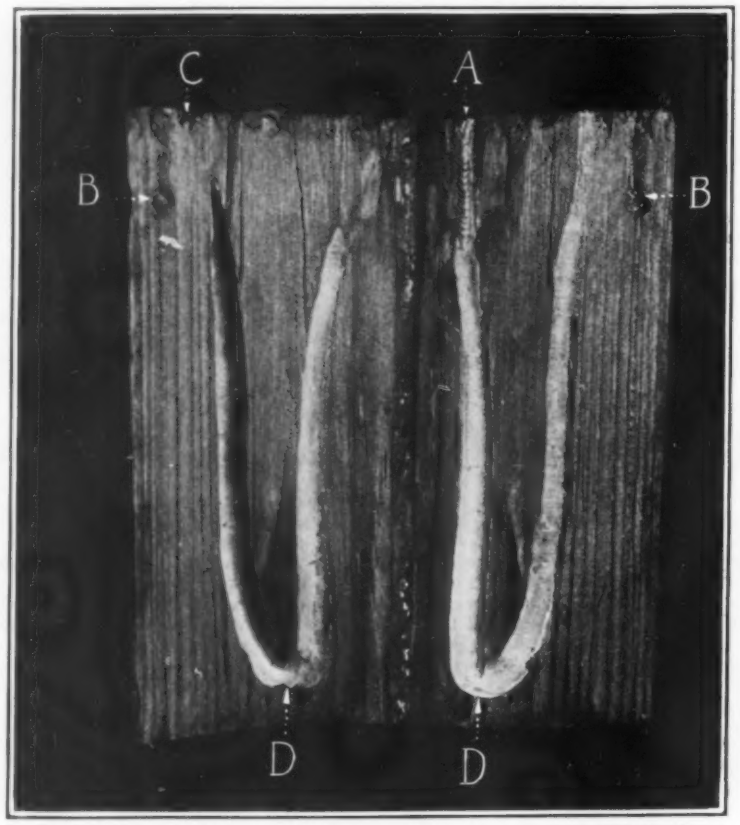
ALTHOUGH engineers and shipbuilders are well aware of the enormous destruction of piers, ferry slips, and all pile construction, which is being wrought by marine borers, the subject is but little known to the general public. How widespread is this destruction is shown by the fact that there is scarcely a port in the world where the marine borers are not at work. What enormous loss they cause is shown in the experience of San Francisco, where the Navy Department had started to build a pile highway bridge between Mare Island and Vallejo, and a few days before the bridge was opened for traffic found that a number of piles had been eaten entirely through at the water-line, and were hanging from the flooring above by the drift-bolts. The piling for the inner structure had to be entirely redriven with creosoted piles. The engineers of various corporations owning waterfront structures in that neighborhood have estimated that the cost of repairs of damage caused by borers, to the end of 1921, was more than $15,000,000.

But we must not imagine that this marine scourge is peculiar to the present age and conditions; for the writings of many of the early Greek and Roman scientists refer to them, and according to a certain German biologist the Bible itself has them in mind when it says "As the worm the wood, so an ugly wife destroyeth her husband." It is a fact that the Phoenicians, and after them the Vikings, charred the outside of their ships and painted them with pitch, as a protection against these organisms. The galleys of Troy were sheathed with lead; and coming down to medieval times we learn that the study of the various species of marine borers dates back to the sixteenth century, when the destruction of the dykes of Holland was so great as to call for preventitive methods.

At the present time an investigation of this vital subject is being carried on by the Committee on Marine Piling Investigations, under the National Research Council, and we are indebted to its Director, Col. W. G. Atwood, for the photographs and data which are herewith presented to our readers. Popularly speaking, marine borers are known under the name of *Teredo*, but as a matter of fact the teredo is only one of several distinct types that are known to science. All destructive borers belong to one or the other of two families, the *Mollusca* and the *Crustacea*. The teredo group belongs to the family of mollusks, and is to be classed with the oyster and the clam. The crustacean group, which is represented by the *Limnoria*, the *Sphaeroma*, and other similar organisms, is allied to the lobster and the crab. Under the mollusks also should be grouped the *Pholas*, the *Martesia* and other forms in which the body of the animal is inside the shell, like that of the oyster.

Of the two groups above, the mollusks, as represented by the teredo (see right of heading), are the more dangerous, for the reason that they enter the wood through minute holes and do their excavating out of sight. The crustaceans (see left of heading) on the other hand attack the surface and bore comparatively shallow holes of small diameter. Hence, they can be readily discovered by inspection. Molluscan borers, such as the teredo, do not obtain any nutriment from the wood or stone; they bore into the matter merely to obtain shelter. They obtain their food from the plankton of the sea in much the same way as the oyster and the clam. It is not quite certain how the crustaceans obtain their food; probably some of them obtain nutriment from the wood.

The teredo and the *Xylotrya (Bankia)* are the most destructive organisms of wide distribution in the United States. The excavating is done by means of hard-lined, shell-like tools which form part of the head of the creature. The shells are actuated by powerful muscles. Some species have teeth that are like a file; the teeth of others are like a wood rasp. The digestive organs, which are located immediately beyond the shells, and the body reach back to the minute hole by which the teredo or similar organism entered the timber. The long worm-like body is encased in a calcareous shell, and the rear end of the animal is equipped with two organs, known as the pallets and the syphons. The syphons are two muscular tubes which normally extend between the two pallets to the outside of the timber. When in this position a constant stream of water, carrying food, passes in through the incurrent syphon, and the corresponding stream carrying the body wastes and the sawdust resulting from the boring passes out through the other syphon. The syphons of the teredo extend from 1 inch to 1½ inches outside the timber; and a pile that is badly infested, Colonel Atwood tells us, looks as if it were covered with gray moss. The growth of the body of the animal is equal to the rate of boring, so that the burrow is always filled. The rate of boring varies from 1 inch to 1½ inches per month for the common species.

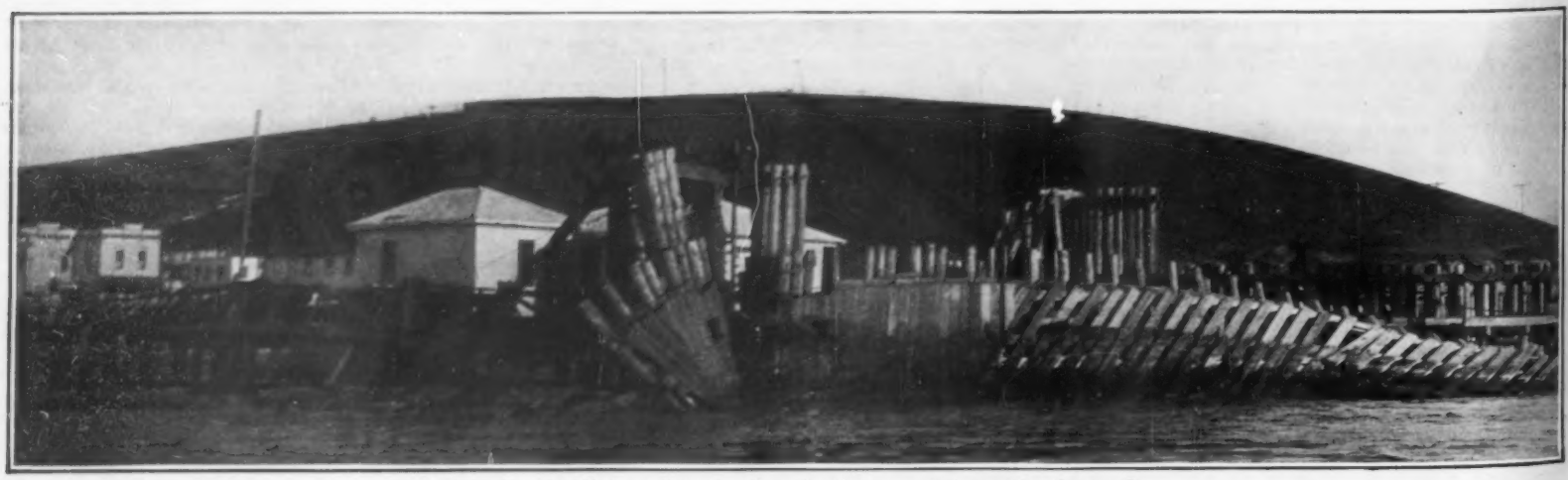


Block of wood split open to show wormlike teredo, surrounded by its calcareous shell

The fecundity of *Teredo Navalis* and *Xylotrya (Bankia)* is enormous. The young of the teredo are born as free-swimming larvæ; whereas the eggs of the Xylotrya (Bankia) are ejected, fertilized, and the larvæ hatched in the water. The Dutch naturalist, Sellius, found in a medium sized Teredo Navalis 1,874,000 larvæ. When we remember that a thoroughly infested pile may contain from 50,000 to 100,000 females, we can realize the rapidity with which these destructive creatures spread.

It will be news to many people that among the molluscan borers is a species which prefers concrete or rock for its depredations, and the *Pholas* or as it is known on the Pacific, the "rock-boring clam," disdains to exhibit its boring ability on mere wood and goes after limestone, sandstone, and even granite, if you please. Although the depredations of Pholas in concrete are not sufficiently widespread to indicate that it is a menace, it can well be understood that a few holes penetrating to the steel reenforcing rods would constitute a great peril to the strength and permanence of reenforced piling.

The Crustacean group includes the limnoria, a little fellow whose depredations are out of all proportion to his size. He is described as having a flat body made up of 14 segments, and he bulks about the size of a grain of rice. As can be seen from our illustrations,



Ferry slip at Vallejo, Calif., the piles of which were destroyed by the teredo

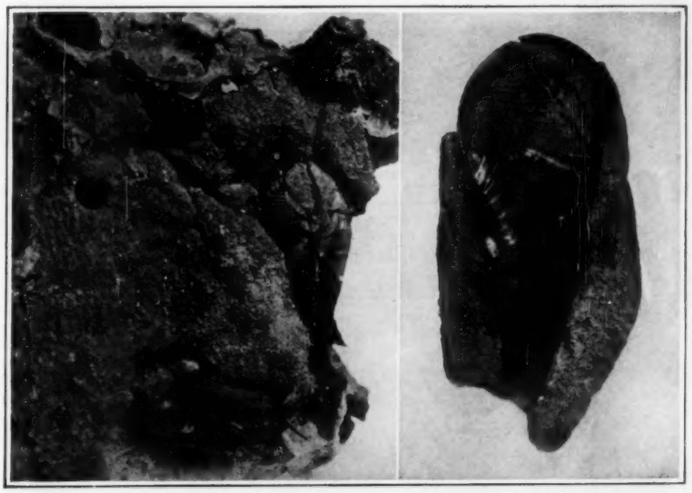
he has stout legs, some of which are equipped with claws like young lobsters. Now, the limnoria chews the wood with its mandibles, making small galleries which are about one-sixteenth inch in diameter and one-half inch deep, and in one specimen examined in San Francisco there were from 200 to 240 burrows per square inch. It is believed that the limnoria uses the excavated wood as food, at least to a limited extent. The accompanying illustrations show three specimens of damaged piles standing side by side; the one to the left shows the depredations of Xylotrya, the one in the center shows how the little limnoriæ nibble away the pile from outside; and the one to the right shows the joint work of limnoria from the outside and of the teredo working its mischief unseen, by boring out the interior of the pile. The last named specimen was secured in March of last year at Manhattan Beach, New York. The Sphaeroma is another crustacean borer which is similar to the limnoria in its bodily structure and its method of work.

Now, marine borers exist in salt water practically all over the world, although the older European reports state that the teredo will not live in water with a salinity below nine parts per thousand. The experiments of the San Francisco Bay Marine Piling Committee indicate that the species maintain a fairly active life with a salinity as low as four or five parts per thousand, and this has been confirmed at Plymouth, England. Furthermore, the San Francisco laboratory has shown that the teredo will work with full efficiency in water so polluted with sewage that there is no free oxygen. Also, it is not affected by industrial works, for it has done its destructive work on the wharves of the Standard Oil and Shell Oil Companies, where the piles attacked were covered by a scum of oil.

As to the rate of destruction, a wharf was completely destroyed by Xylotrya in 18 months, in Resurrection Bay, Alaska, and a platform for carrying test pieces at a wharf at Pensacola, Florida, was destroyed in 30 days. The *Teredo Navalis* and its brother *Xylotrya*, which wrought the damage noted above, will ordinarily destroy a 14-inch pile in three months. The rate of destruction by the crustacean is lower than that by the *Mollusca*.

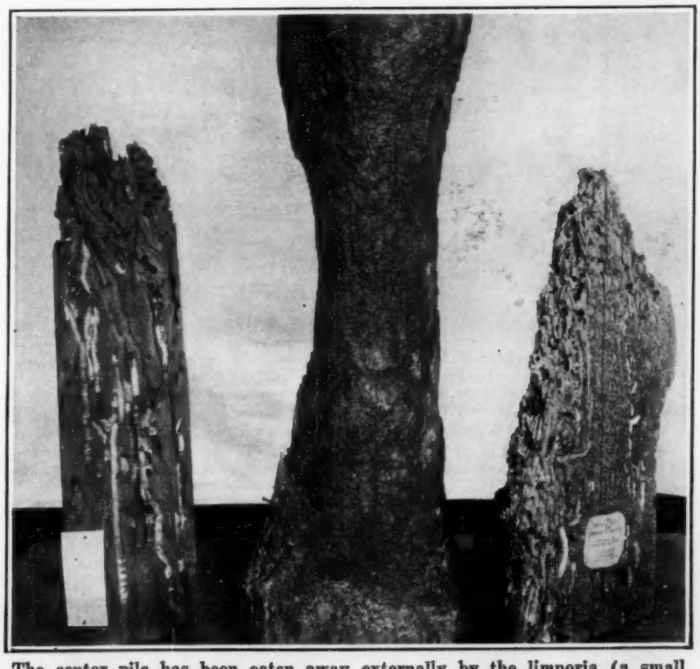
The Committee on Marine Piling Investigations is making a study of the possible methods of protection against these destructive and very costly pests. Three methods are suggested. The first includes protection by charring the outside of the timber; by the use of built-up piles; and by the use of unbarked piles, but they consider that none of these methods has any permanent value. The second method is mechanical. It consists either of painting or of coating the pile with paint compounds, using metal sheathing, earthenware pipe, concrete or some form of elastic coating. Surface treating with paint or other materials has the objection that it may be damaged or destroyed from rough handling during construction. It may give temporary protection, but is not permanent; the metals used for sheathing are lead, rolled iron, copper, zinc, several alloy metals, and cast iron. The objection to this method is that the metals corrode, and that some of them, like copper, are so valuable that they are stolen. Another objection is that if the coating is torn or any kind of opening is made through it, the marine borers get in and do their work. The Dutch have a method of nailing which consists of driving the pile full of large headed nails until the surface is covered by the heads. This, however, is expensive, and the industrious little limnoria are reported to have dug out the nails and opened a way for the teredo. Again piles have been wrapped with a fabric impregnated with asphalt. This is good until an opening is made in the coating, and, of course, it is difficult to drive a pile without breaking the coating.

Impregnation with many metallic salts and other supposedly poisonous chemicals has been tried, and creosote seems to give the best protection. Creosote, however, is a trade name, and its content may vary. Several college laboratories, and the Forest Products Laboratory, are investigating the creosote protection to discover whether their effect on the borers is that of a poison or whether there is some constituent which prevents the larvæ from landing on the timber. Col. Atwood states that some structures built with the creosote piles have had a life of 30 years or more in badly infested water, but he informs us that since such cases are rare we should be careful in drawing conclusions.



Pholas, or rock-boring clam, shown boring its way into a mass of concrete. It has been found in sandstone, limestone, and even granite

Finally, it has been suggested that some indigenous woods would resist borer action, but unfortunately such timbers as the Palmetto and some of its relatives have but little strength, and decay rapidly above water level. The Greenheart of Demara is reported to have given long life in some foreign harbors. From other localities come reports of failure. This wood was used in the lock-gate sills and similar places in the Panama Canal.



The center pile has been eaten away externally by the limnoria (a small crab-like animal). The outer specimens show destructive work of the teredo, a wormlike borer

It failed and had to be removed. Australian turpentine wood was reported to have given good results at Victoria, B. C., during a trial of eight years. Other British Colonial harbors have sent in favorable reports and the subject is being investigated.

As a result of the investigations of the Committee on Marine Piling, it is about to determine, first, what species of borers exist and where; secondly, what the salinity, temperature, oxygen content, and hydrogen ion concentration are, and their effect on the various borers; and why it is that one creosote protects piling and one does not. When the investigations are completed the committee believes it will be possible to draw a specification for creosote that will permit the removal of all constituents that are not necessary for protection but are of value for other purposes, and to leave a substance that will give effective protection. The committee also hopes to give a report on suitable substitutes for timber construction that may be used on waterfront structures.

Cheaper and Better Houses

THE Building Code Committee of the Department of Commerce has recently made public a report dealing with the production of cheaper and more durable houses. In speaking of this report, Secretary Hoover credits it with "a value far beyond any similar work undertaken to date."

The committee has included not only the minimum requirements which it believes should be enforced by cities in their building codes for all one and two-family houses, but also an appendix discussing good practice in small house construction. In this way the 100-page printed report not only serves the primary purpose of presenting a model ordinance which cities may adopt, but will be a useful guide to all who are interested in knowing where to save and where to spend in order to obtain a safe, substantial and durable house at a minimum cost. Thirty illustrations are included to explain the text.

The report is believed to represent by all odds the most thorough investigation that has yet been made of the engineering and practical side of house building. This subject has never before received even a small part of the expert study which its importance warrants, and hence millions of our small houses have been built with needless waste of some materials, yet with neglect of simple precautions necessary for comfort and durability.

This first report of the committee deals with the construction of one and two-family houses of masonry, concrete and frame types, the latter including veneer and stucco. The value of such construction in the United States amounted to well over a billion dollars in 1922. It is expected that general adoption of the code with consequent modification of present unjust and wasteful requirements will result in substantial conservation of material and the saving of many millions of dollars.

Electron Tube Detector Unit for Radio Reception

ANNOUNCEMENT has previously been made of the publication of Bureau of Standard Circulars 120 and 121 entitled "Construction and Operation of a Simple Homemade Radio Receiving Outfit" and "Construction of a Two-Circuit Radio Receiving Equipment with Crystal Detector," respectively. These two circulars describe crystal detector receiving sets and either of them can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 5 cents a copy.

To meet what appears to be a very considerable demand, the Bureau of Standards has prepared Circular No. 133 entitled "Description and Operation of an Electron-Tube Detector Unit for Simple Radio Receiving Outfits." This circular describes in detail the construction and operation of a simple electron-tube detector unit which will give a more sensitive set than one employing a crystal detector and may, therefore, be expected to give more satisfactory results. Much of the apparatus belonging to the sets described in Circulars 120 and 121 can be used for the new arrangement, and the cost of the electron-tube detector unit alone, including tubes, is estimated to be not greater than $8 to $14. In addition, however, batteries will have to be purchased which add about $20 to the cost of the outfit, if a storage battery is employed instead of a dry battery.

Circular 133 can be purchased from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 10 cents per copy.

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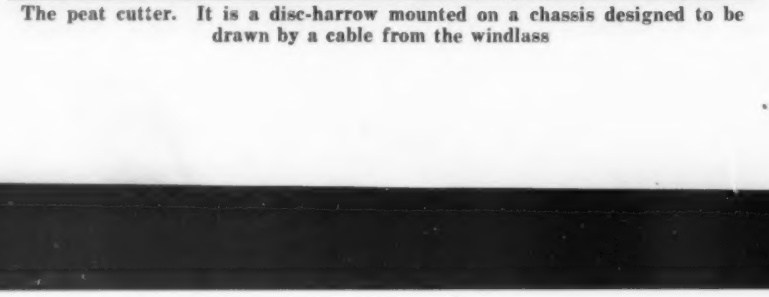

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The exposition grounds cover an area of seventy-five acres, while two years have been occupied in the erection of the buildings, some of which are examples of the finest types of architecture. Among the buildings worthy of special notice is Memorial Hall, which is the architectural feature of the exposition. This structure contains a portrait gallery of all the great men and women of Gothenburg and vicinity. All the official receptions and other festivities in connection with the exposition will be held in Memorial Hall.

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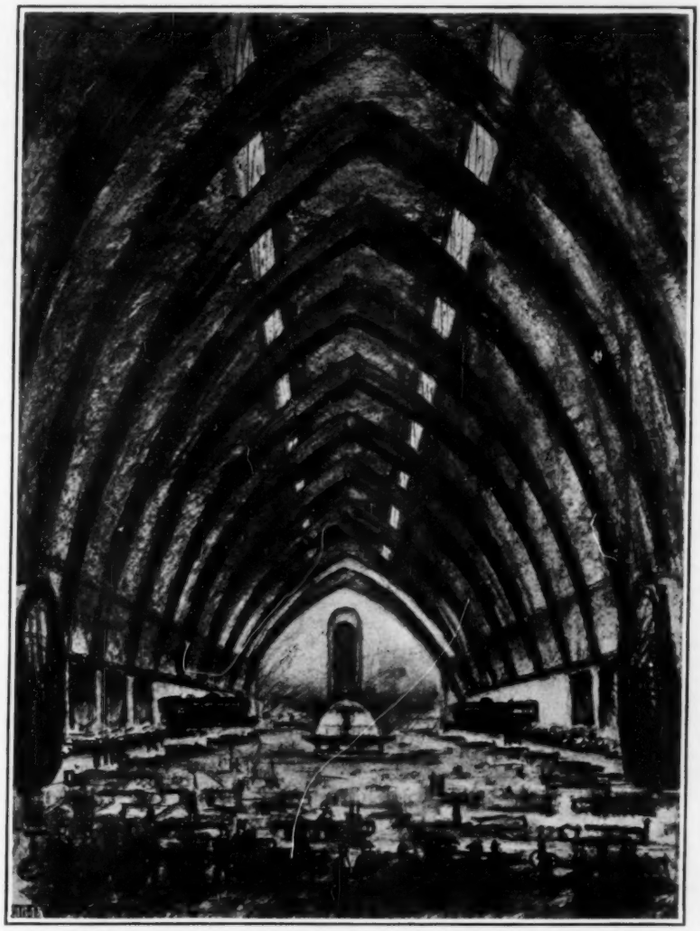
The foreign Swedes exhibition records the history of the Swedes who have traveled to and settled in foreign lands. Here are relics, models, pictures, charts, etc., from North and South America, from Asia, Africa and the non-Scandinavian countries of Europe. The United States is strongly represented, with exhibits from Colonial days on the Delaware, and from later settlements throughout the country between the Atlantic and the Pacific coasts.

A series of broad granite steps lead up to the Art Museum, which is a structure of stone with a beautiful facade, and its front is adorned with a row of sculptured figures. This museum now houses the older art of the exposition and it will become a permanent addition to Gothenburg's art museums.

Among the exhibits of short duration will be the First International Aviation Exhibition in Scandinavia, which no doubt will attract the latest types of flying craft from all parts of the world.



Interior of Machinery Hall. The entire structure is of wood, while the vaulted roof is the largest of the type ever constructed

Gothenburg ter-centennial exposition structure

The Meaning of Grade A, Grade B or Grade C with Reference to Milk

MILK is graded according to bacteriological content; not, as many people think, according to the amount of cream it contains. In other words, Grade A milk is not necessarily richer in cream than the B or C grades, contrary to general opinion.

It is the number of bacteria found in milk which determines how it is graded. Grade A milk contains the fewest bacteria; there being no more than thirty thousand per cubic centimeter in this grade after pasteurization. In Grade B milk there are no more than one hundred thousand bacteria per cubic centimeter. In Grade C milk there are no more than three hundred thousand bacteria per cubic centimeter.

The bacteria in milk are considered generally, nonpathogenic; that is, non-creative of disease. All milk contains bacteria under ordinary circumstances, and their presence in this food is expected.

If milk were tested and found not to contain bacteria it would immediately be suspected of containing preservatives, which are more harmful to the health than the bacteria common in milk. On the other hand, the presence of too many bacteria in milk indicates carelessness in the handling, and this, in turn, might some time invite bacteria not entirely harmless. Therefore, the importance of testing milk for the bacteriological content.

The test for counting the number of bacteria in milk is simple. This does not mean that you or I, without a laboratory where sterile precautions are possible, and without the knowledge of laboratory technique, could perform that test.

But taking the miracle of sterile precautions for granted, there is very little work to counting the bacteria in milk.

About two drops of the milk are placed upon a small glass dish. This is mixed with agar, a rich stiffened bouillon in which all bacteria thrive. The dish is then sealed and placed away in an incubator, in a temperature conducive to germ life. After twenty-four hours the bacteria will show all over the surface of the glass dish in clusters of white plainly enough to be counted by the naked eye.

Many other kinds of tests are often made of milk, but the most common specific test is the test for bacteria of the colon group. The absence of colon in milk is generally accepted as a proof of the cleanliness in the handling of milk, especially the cleanliness of the stables and of the utensils used there. The colon test is much more complicated than the test for the numerical content of bacteria.

And, speaking of tests for milk, the health of cows whose milk ultimately reaches the market, must be tested, too, every year.

As for the amount of cream on the milk you buy, this has no standard unless you pay for milk which is marked certified. Certified milk, according to New York law, may not contain less than 4 per cent of butter fats. Therefore, those cows that do not give at least 4 per cent of cream cannot have their milk called certified and sold at "certified" prices.

The law also states that nothing may be added or taken away from milk sold as certified.

The bacteriological count of milk is kept low by various precautions. If the stables are neat and sanitary, the milkers' hands clean, the pails and containers well scalded, and the milk kept on ice until it reaches the consumer, it is sure to be Grade A, and worth a cent or two more for all this trouble.

And the fewer the precautions, scientific research says, the greater will be the numbers of bacteria found in milk.

Analogy Between Electrical Waves and X-Rays

IN the *Annalen d. Physik*, No. 18, 1922, N. Kapzov presents the results of experiments performed at the University of Moscow on the analogy between electrical waves and X-rays. About a third of a century ago, when Hertz's demonstration of the actual existence of those electrical waves predicted by Maxwell was still so recent that the wonder of it was still undulled by familiarity, it was no uncommon experience to meet in the periodical literature of physics some new proof that the new waves comported themselves in the same manner as light waves. Their reflection, refraction and interference were thus established. Then came the discovery of the X-rays and the battle between the conflicting views as to their nature. It is now known that they are light waves of extremely short length. For a long time it seemed impossible to reflect them from a surface. Now it is known that the surface of a crystal does this, and does it because within it are arranged layer after layer of atoms and electrons in regular order, though in fact diffraction is the real cause. This paper shows that the same effects are obtained when electrical waves, enormous in comparison with X-rays, are allowed to fall upon an artificial crystal. The elements are hollow copper cylinders, 12 millimeters long and 3 millimeters in diameter. Several of these are hung at equal intervals on a vertical thread. A sheet is formed by placing many such threads in the same plane, and, finally, the crystal is made by placing several sheets parallel to one another and at equal distances. The electrical waves are of wave-length 3.5 centimeters. The cylinders act as resonators for the electrical waves.

When a bundle of electrical waves falls on the artificial crystal a reflected wave results and the intensity of this is measured as the crystal rotates, thus changing the angle of incidence. As the crystal turns the intensity of the reflected wave passes through maxima and minima, just as is the case with X-rays reflected from a natural crystal. More than this, when the positions of the crystal for maximum and minimum reflections are observed and the X-ray formula for the wave-length is applied, the result of the calculation is 3.2 centimeter. This may seem not sufficiently close to the value already given, 3.5 centimeter. When, however, the length of the waves was measured in the beam reflected from the crystal it was found to be 3.2 centimeter. Thus the two methods give concordant results. By some resonance effect the cylinders make the length of the reflected wave less than that of the incident wave.

The reflection was studied with one, then with two sheets and so on. The addition of the second sheet to the first caused a notable increase in the strength of the reflected ray, the third sheet produced a smaller increase and the presence of more sheets scarcely had any effect, thus showing that the reflection takes place almost entirely from the superficial layers of the crystal screen and not from the deeper ones.

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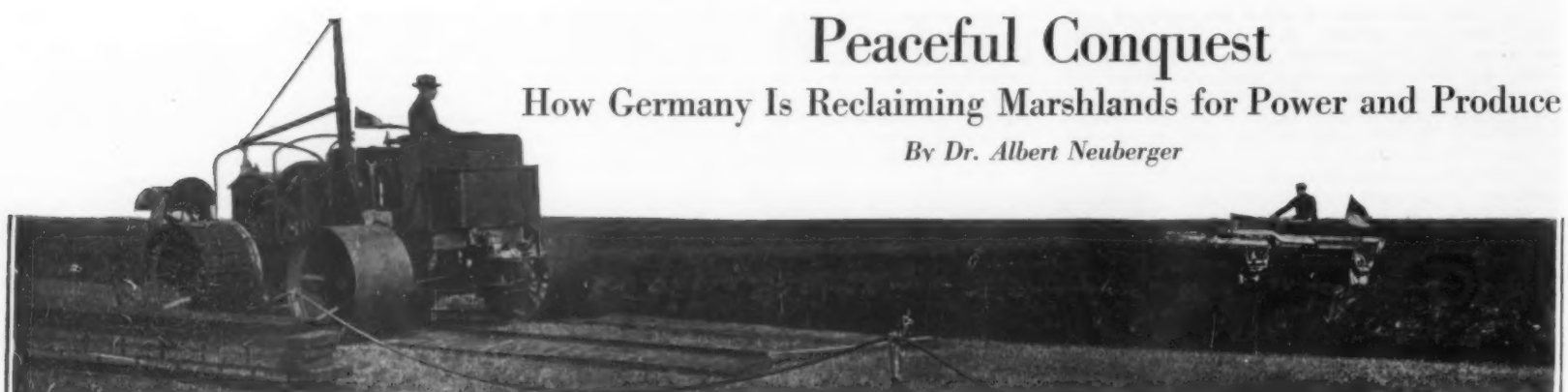

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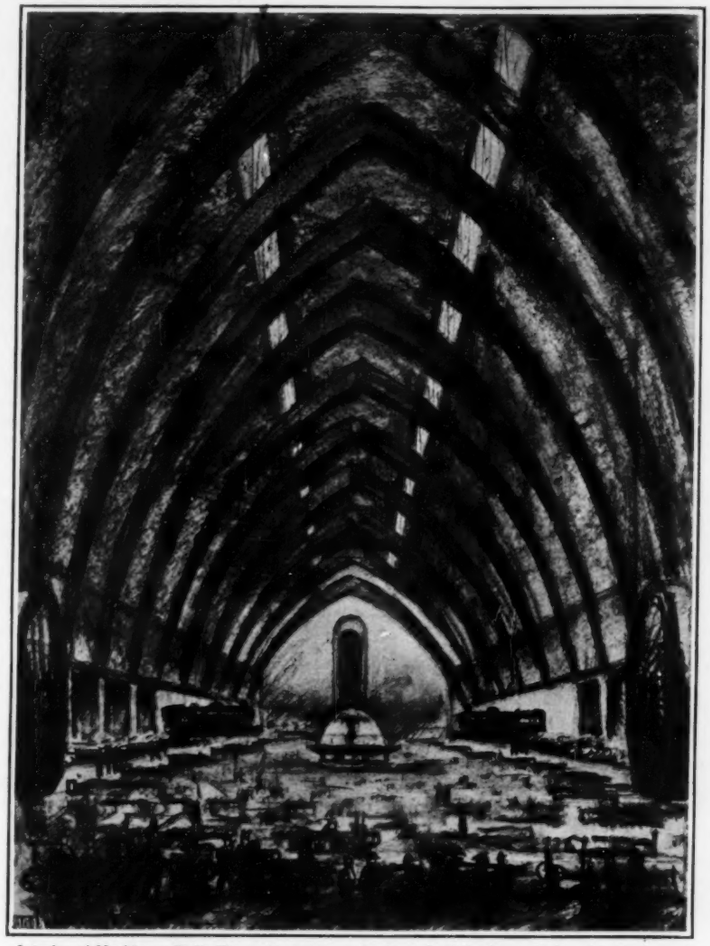
Machinery Hall, built entirely of wood, has the largest vaulted roof ever constructed. This building contains a bewildering array of products representing modern Swedish industry. Among these exhibits are electric motors, oil motors, machines for working wood and iron, the famous Swedish ball-bearings, tool-making machines, road-building machines, farming implements, cream separators, etc. There is a building devoted chiefly to the chemico-technical industries. Forestry and wood products are grouped in a separate building, picturesquely set in a grove of trees. Particularly vivid is the demonstration of how paper is made, from the time the tree is cut in the forest until the sheet is ready for the printing press.

The fisheries exhibit is one of importance. Here the visitors have the opportunity to learn not only how Swedish herring, mackerel, stock-fish and "strömming" look in life, but also how they are caught and prepared for consumption. There are fishing vessels, sheds and huts in model form, and the various types of fishermen's equipment illustrate vividly in complete series how this fundamental industry of human sustenance has developed through the centuries.

The foreign Swedes exhibition records the history of the Swedes who have traveled to and settled in foreign lands. Here are relics, models, pictures, charts, etc., from North and South America, from Asia, Africa and the non-Scandinavian countries of Europe. The United States is strongly represented, with exhibits from Colonial days on the Delaware, and from later settlements throughout the country between the Atlantic and the Pacific coasts.

A series of broad granite steps lead up to the Art Museum, which is a structure of stone with a beautiful facade, and its front is adorned with a row of sculptured figures. This museum now houses the older art of the exposition and it will become a permanent addition to Gothenburg's art museums.

Among the exhibits of short duration will be the First International Aviation Exhibition in Scandinavia, which no doubt will attract the latest types of flying craft from all parts of the world.



Interior of Machinery Hall. The entire structure is of wood, while the vaulted roof is the largest of the type ever constructed

Gothenburg ter-centennial exposition structure

The Meaning of Grade A, Grade B or Grade C with Reference to Milk

MILK is graded according to bacteriological content; not, as many people think, according to the amount of cream it contains. In other words, Grade A milk is not necessarily richer in cream than the B or C grades, contrary to general opinion.

It is the number of bacteria found in milk which determines how it is graded. Grade A milk contains the fewest bacteria; there being no more than thirty thousand per cubic centimeter in this grade after pasteurization. In Grade B milk there are no more than one hundred thousand bacteria per cubic centimeter. In Grade C milk there are no more than three hundred thousand bacteria per cubic centimeter.

The bacteria in milk are considered generally, nonpathogenic; that is, non-creative of disease. All milk contains bacteria under ordinary circumstances, and their presence in this food is expected.

If milk were tested and found not to contain bacteria it would immediately be suspected of containing preservatives, which are more harmful to the health than the bacteria common in milk. On the other hand, the presence of too many bacteria in milk indicates carelessness in the handling, and this, in turn, might some time invite bacteria not entirely harmless. Therefore, the importance of testing milk for the bacteriological content.

The test for counting the number of bacteria in milk is simple. This does not mean that you or I, without a laboratory where sterile precautions are possible, and without the knowledge of laboratory technique, could perform that test.

But taking the miracle of sterile precautions for granted, there is very little work to counting the bacteria in milk.

About two drops of the milk are placed upon a small glass dish. This is mixed with agar, a rich stiffened bouillon in which all bacteria thrive. The dish is then sealed and placed away in an incubator, in a temperature conducive to germ life. After twenty-four hours the bacteria will show all over the surface of the glass dish in clusters of white plainly enough to be counted by the naked eye.

Many other kinds of tests are often made of milk, but the most common specific test is the test for bacteria of the colon group. The absence of colon in milk is generally accepted as a proof of the cleanliness in the handling of milk, especially the cleanliness of the stables and of the utensils used there. The colon test is much more complicated than the test for the numerical content of bacteria.

And, speaking of tests for milk, the health of cows whose milk ultimately reaches the market, must be tested, too, every year.

As for the amount of cream on the milk you buy, this has no standard unless you pay for milk which is marked certified. Certified milk, according to New York law, may not contain less than 4 per cent of butter fats. Therefore, those cows that do not give at least 4 per cent of cream cannot have their milk called certified and sold at "certified" prices.

The law also states that nothing may be added or taken away from milk sold as certified.

The bacteriological count of milk is kept low by various precautions. If the stables are neat and sanitary, the milkers' hands clean, the pails and containers well scalded, and the milk kept on ice until it reaches the consumer, it is sure to be Grade A, and worth a cent or two more for all this trouble.

And the fewer the precautions, scientific research says, the greater will be the numbers of bacteria found in milk.

Analogy Between Electrical Waves and X-Rays

IN the *Annalen d. Physik*, No. 18, 1922, N. Kapzov presents the results of experiments performed at the University of Moscow on the analogy between electrical waves and X-rays. About a third of a century ago, when Hertz's demonstration of the actual existence of those electrical waves predicted by Maxwell was still so recent that the wonder of it was still undulled by familiarity, it was no uncommon experience to meet in the periodical literature of physics some new proof that the new waves comported themselves in the same manner as light waves. Their reflection, refraction and interference were thus established. Then came the discovery of the X-rays and the battle between the conflicting views as to their nature. It is now known that they are light waves of extremely short length. For a long time it seemed impossible to reflect them from a surface. Now it is known that the surface of a crystal does this, and does it because within it are arranged layer after layer of atoms and electrons in regular order, though in fact diffraction is the real cause. This paper shows that the same effects are obtained when electrical waves, enormous in comparison with X-rays, are allowed to fall upon an artificial crystal. The elements are hollow copper cylinders, 12 millimeters long and 3 millimeters in diameter. Several of these are hung at equal intervals on a vertical thread. A sheet is formed by placing many such threads in the same plane, and, finally, the crystal is made by placing several sheets parallel to one another and at equal distances. The electrical waves are of wave-length 3.5 centimeters. The cylinders act as resonators for the electrical waves.

When a bundle of electrical waves falls on the artificial crystal a reflected wave results and the intensity of this is measured as the crystal rotates, thus changing the angle of incidence. As the crystal turns the intensity of the reflected wave passes through maxima and minima, just as is the case with X-rays reflected from a natural crystal. More than this, when the positions of the crystal for maximum and minimum reflections are observed and the X-ray formula for the wave-length is applied, the result of the calculation is 3.2 centimeter. This may seem not sufficiently close to the value already given, 3.5 centimeter. When, however, the length of the waves was measured in the beam reflected from the crystal it was found to be 3.2 centimeter. Thus the two methods give concordant results. By some resonance effect the cylinders make the length of the reflected wave less than that of the incident wave.

The reflection was studied with one, then with two sheets and so on. The addition of the second sheet to the first caused a notable increase in the strength of the reflected ray, the third sheet produced a smaller increase and the presence of more sheets scarcely had any effect, thus showing that the reflection takes place almost entirely from the superficial layers of the crystal screen and not from the deeper ones.

Getting Our Money's Worth in Fertilizer

Simple Facts About the Intricacies of the Fertilizer Problem as Viewed from Many Angles

By Harry A. Mount

THE complex chemical and biological processes which take place in soils are so imperfectly understood, and the range of expert opinion on the value of the various types of fertilizers is so wide, that to the impartial observer it would be not at all surprising if something of a revolution in our fertilizer practice should take place in the near future.

It is only within the past decade that our scientists have seriously undertaken a study of the fertilizer problem, and we are just coming to realize its importance to the prosperity of the nation. We have made swift progress in ten years, but are still only at the dawn of a better day for all those who depend directly or indirectly upon the soil for their sustenance and means of livelihood.

Revolving tubular dryer for treating peat in preparing it for admixture with fertilizer

A farming community may have good homes, good roads, good schools, good postal service, good transportation service, willing labor and the other desirable things, but without a fertile soil all these are in vain. Only a few years ago there were in this country vast tracts of virgin soil to be had for the taking, and it was easier to move to these new lands than to maintain the old ones. To attest to this extravagant system we have great areas of abandoned farms scattered along the Atlantic coast from Maine to Virginia, especially in New Hampshire, Vermont, western Massachusetts, and northern New York. These areas were the first abandoned because they were the first populated. Now the virgin fertility of our great western and mid-western farming areas is coming to an end. Between the years 1880 and 1900 land values in Ohio shrank $60,000,000 from this very cause and in the face of a great increase in population. There are still farms in this country which will yield bumper crops without much attention being paid to fertility, but on the whole America at last faces a situation which demands that she pay back to Nature in the form of fertilizers unit for unit the plant food values she gathers so abundantly from the soil.

Every crop we harvest, every hog we butcher, every egg that is laid, removes from the soil a definite amount of its essential plant food values. Where man does not interfere with the processes of Nature a balance between the plant food taken from the soil and that returned to it is maintained and no impoverishment takes place. Plants die on the spot where they grew and return to the soil in decay the very values they extracted in life. In the aggregate, the same thing is more or less true of primitive animal life and was true of man, when he lived wholly on the land and provided his every want from the fruits of his own efforts. But the growth of great urban populations has changed this.

Hundreds of tons of food products go into New York City daily, representing so much soil value permanently removed, for only a negligible amount is ever recovered and returned to the land. The greater portion is finally spread out on the floor of the sea, carried there in the form of sewage, garbage, and other municipal and industrial wastes.

The agricultural scientist has discovered that the chief plant foods taken from the soil by this wasteful process which is going on in most American communities, are nitrogen, phosphoric acid and potash. While we are throwing away thousands of tons of these materials every day. We literally go to the four corners of the earth to large natural deposits of the same elements to replace what we have thrown away. America has highly concentrated natural deposits of only one of these essential plant foods, phosphoric acid, found in the phosphate rock of Tennessee and Florida. We go to Germany and Alsace for nearly all of our potash and to Chili for our nitrates.

At the present time the market value of a fertilizer is determined almost exclusively by the percentage in it of each of these three constituents. For instance a fertilizer may contain six "units" (six per cent) of nitrates at a market value of so much a unit, eight units of phosphoric acid at so much a unit, and two units of potash at so much a unit, the total value of the three being the market value of the fertilizer.

This method takes into consideration no other ingredients, whether these be valueless sand or valuable humus. Furthermore, the standard method of determining the amounts of these three elements present shows only the volume of each present in a form immediately available as plant food, that is, only that portion of each which is soluble in water. Considered on this basis ordinary stable manure is almost worthless, and yet every farmer knows its value as a soil builder. There are thousands of farmers throughout the United States who would prefer stable manure to commercial fertilizer if it could be had in sufficient quantity. That is because, locked up in the organic structure of manure, there are all the elements taken from the soil by plant growth and in exactly the proportion that they need to be returned to the soil. A small part of these elements is immediately available as plant food, made so by the digestive process of the animals. But the greater part of this plant food value only becomes available as the manure slowly rots in the soil, and it is released throughout the growing season. Some of the value is even carried over into the succeeding seasons. Of such values the present standard methods of arriving at fertilizer values takes no account.

But manure is not a concentrated product; relatively large quantities of it are required to obtain the desired results. It cannot be shipped long distances economically and so can be used at a profit only near the source of supply. If we were to attempt to supply the Southern cotton belt with the enormous amounts of fertilizers used there annually, with a product of the general character of stable manure, we would find that most of the profits from its use would go to pay the freight bills on it.

Since the great bulk of fertilizers used everywhere have to be shipped some distance from the source of production, it is desirable to have the product as concentrated as possible. The most concentrated form which a fertilizer can take is a combination of the pure chemicals which form the principal plant foods. Sometimes fertilizers are sold in this form, but unless the farmer who receives it is thoroughly familiar with its use and then exercises the greatest care, he may "burn" his crops and do more injury than good. It is the usual practice to dilute the raw chemicals with sand or some other "carrier" in order to insure better results to the average farmer. Thus it often happens that the farmer pays freight charges on a product which is one-fourth plant food and three-fourths sand, which lies inert in the soil and does no good. The amount wasted annually in paying freight on sand amounts to many thousands of dollars, for the fertilizer industry is an enormous one which counts its receipts in the tens of millions.

In many States there are laws which discourage the sale of certain forms of the so-called low-grade fertilizers, or fertilizers containing them, and this together with the tests prescribed for determining values, practically forces the farmer to buy a fertilizer of the type we have just described. As a matter of fact, the farmer is often better pleased with such a fertilizer than he would be with one which in the end might be more valuable to him. It puts into the soil a large amount of plant food, all or nearly all of which is immediately available. He sees an immediate effect upon his crops and so feels that he has his "money's worth."

But for the very reason that the plant food is all available, that is, in a soluble form, much of it is often lost before it becomes effective. A series of heavy rains soon after the fertilizer is applied may wash out most of the chemicals and bear them away to creek, river and sea.

There are two possible remedies which suggest themselves for such a situation. The first is to determine under government supervision the value in dollars of any commercial fertilizer by uniform growing tests on the soil. In the final analysis the value of any fertilizer ought to depend not upon the volume and form of certain chemicals it may or may not contain, but upon the increase in crop yield it produces. Widely known soil experts have urged the adoption of the plan suggested. But there are very real dif-

Large compost piles of peat which is being prepared for use with fertilizer

ficulties to the practical application of this test, which we need not consider here. There seems to be little likelihood at present that the suggestion will be followed.

The second remedy is already in limited use and needs only to be extended according to the dictates of common sense to become effective. This remedy consists in using an organic "filler" instead of sand for commercial fertilizers. Such a filler would also add its quota of plant food to the soil as it decayed, and the farmer would not be paying a freight bill on a useless material. Such a fertilizer might cost a little more than the standard commercial product now costs. According to present standards it would be rated no higher, but even if the farmer paid the increased cost he would get more value dollar for dollar and ton for ton than he now receives.

Dried tankage, which is a by-product of packing houses, was formerly used principally for this purpose. This tankage usually contains 10 or 12 per cent of ammonia, which in the soil is converted to a slightly smaller amount of nitrogen, and in addition contains some bone phosphate of lime. It is only necessary, therefore, to "dose" the tankage with additional chemicals to bring it up to the present standard of a commercial fertilizer, for which there is a ready market. But it has been found that packing house tankage also contains all of the ingredients of a good hog and stock food and as such, it commands a higher price than when used in fertilizer. For this reason very little of it is now used for the latter purpose. This is also true of the similar tankage obtained from rendering such wastes as the bodies of dead animals and fish scrap.

There is one form of tankage which may come to be of great importance for use in fertilizer. This is produced from city garbage. The presence of grease in garbage tankage was for many years a drawback to its use for this purpose. The grease caused spontaneous combustion when the material was stored in large quantity, resulting in much property damage, and when put into fertilizer it clogged the pores of the soil and prevented the free passage of air and water. But the most advanced type of garbage reduction plant now produces a tankage entirely free from grease, and which of itself has a fertilizing value superior to that of stable manure.

Garbage tankage also contains the ingredients of a good stock food, but there is one circumstance which probably will prevent any wide use of it for that purpose. American housewives have not been educated to the fact that broken dishes, old lamp bulbs, phonograph needles and tin cans do not belong in the garbage can, and so some of this indigestible material gets into the finished tankage. No economical way has been found to get it out and so for a time, at least, the bulk of garbage tankage will probably be used as fertilizer. But the very fact that there is little demand for this sort of fertilizing

(*Continued on page 430*)

Tankage in a modern municipal garbage reduction plant, an excellent fertilizer which is at present begging for a market

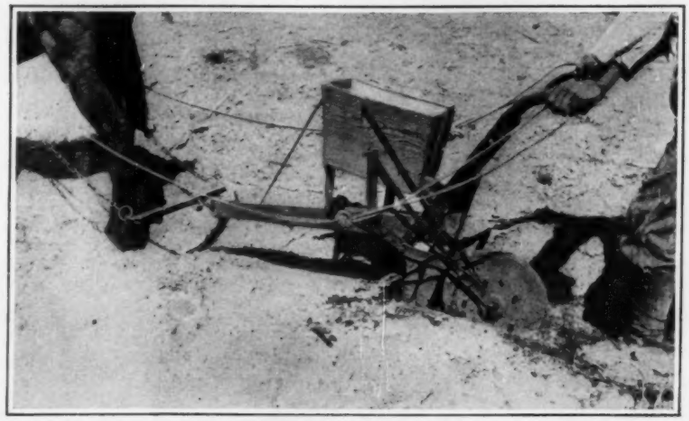
A Home-Made Distributor for Fertilizer

THE device shown in the accompanying illustration is for the distribution of commercial fertilizer in rows prior to the planting of crops. With the exception of the wooden hopper which carries the fertilizer and the wooden wheel that rolls behind the plow, it is made entirely of salvaged fittings, and may be attached to an ordinary single plowstock.

A home-made wooden hopper eight inches wide, sixteen inches long and twelve inches deep for carrying the fertilizer is suspended between the upright ends of a piece of band iron curved under the beam of the plowstock and bolted securely to it on the sides. The upper ends of this piece of band iron form a balancing pivot on which the hopper oscillates in order to keep the stream of fertilizer moving along. Another piece of lighter band iron three feet long is bolted in two places to the left side of the hopper box in a diagonal position and extends downward sufficiently to make contact with the vibrator pins on the wooden roller running behind the plow. This roller is twelve inches in diameter and has several iron pins in a circle, near the hub. These are for actuating the agitating lever. A long coil spring such as is used generally for keeping screen doors closed is attached to the front of the hopper in order to insure that it will return to position when it has been rocked by the agitating lever. The lower end of this lever is forged edgewise onto a curve so that it will pass the pins of the rear wheel without too much suddenness. As the pins rotate with the rolling of the wheel, each one catches the end of the agitator lever, pulling it downward about an inch. As it slips off the pin the coil spring pulls the hopper back to its original position.

As an exit for the fertilizer a small, square hole is cut at the rear end of the hopper. This is connected by means of a small tin trough to the nearly vertical tube of tin which distributes the fertilizer along the furrow. This prevents the wind from scattering the fertilizer. In order to regulate the flow of fertilizer a small slide running between guides is placed over the opening in the hopper and this is held in the desired position by means of a thumbscrew.

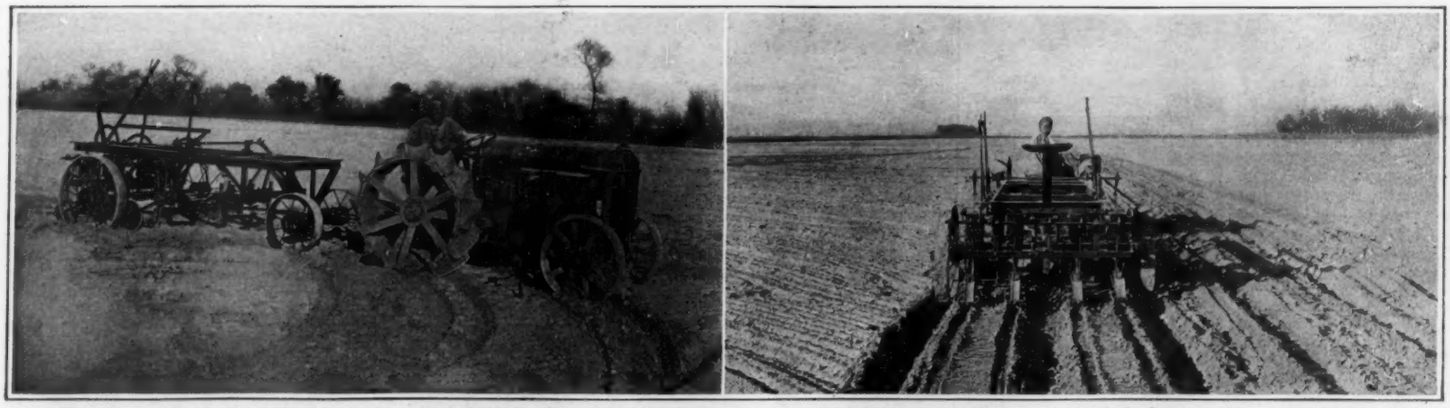
This device may very easily be attached to and detached from an ordinary plowstock and saves much time and labor as compared with the old way of carrying fertilizer in buckets and distributing it by hand. It operates on about the same principle as the manufactured distributor and can be made at almost no cost, using junk parts to be found around any place.



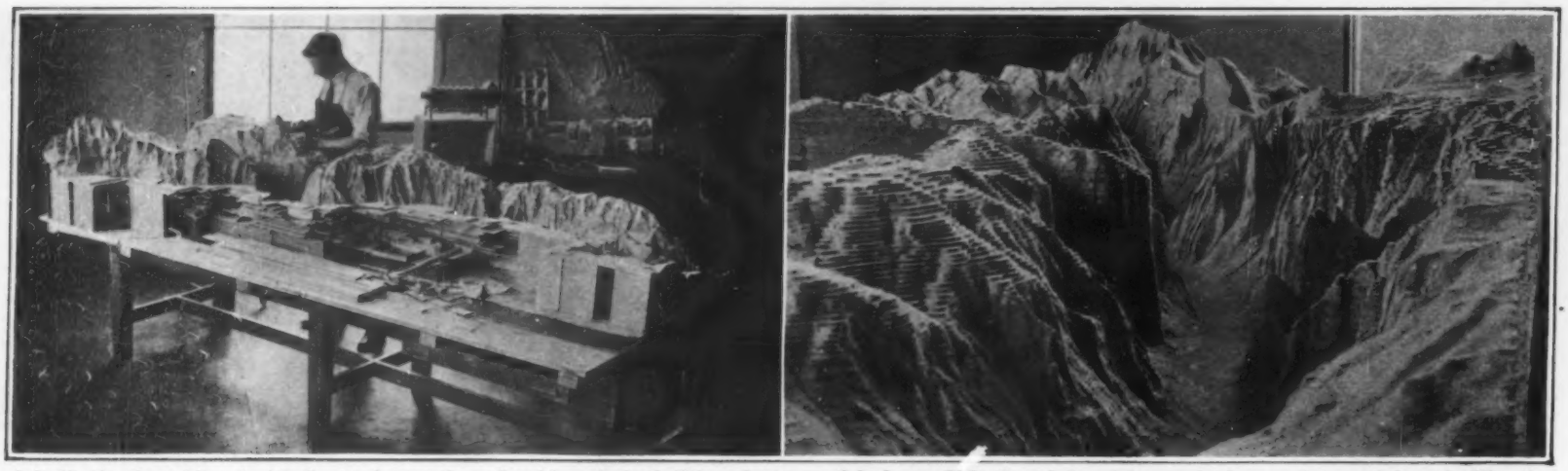
Home-made fertilizer distributor attached to ordinary plowstock

Planting an Acre and a Half an Hour

A FARM implement that combines the functions of a seeder, ridger, planter, packer and cultivator is the outcome of a labor shortage on a California ranch. This machine, which is designed to be drawn by the average 20-horsepower tractor, recently planted 4½ acres at one trip over the ground in three hours' time and was thus able to replace the united labor of eleven men and from six to eight horses. It plows the soil deeply, ridges it, as shown in the illustration, runs in a double row of seed, and covers the seed all at one operation. It enables perfect alinement of rows, for if the first row is put in with a range pole, the rest of the field can be put in with a parallelism far better than is possible with any horsedrawn implement, the driver of the tractor being in a position to see any irregularities which have crept into the previous row and shave them off as the tractor passes them. This facilitates the later operations of cultivating, etc. The performance of the whole group of seeding operations at once prevents drying out of the soil moisture in the drill and thus enhances the chances of a better germination of the seed. Such an implement as this can be made up by a farmer who is equipped with a few tools for metal working. Parts of discarded implements often work up very conveniently for this purpose.



Left: **Implement which ridges the prepared seedbed, drills in the seed and covers it at one operation, replacing eleven men and six horses. It may be drawn by any 10-20 horsepower tractor.** ***Right:*** **Showing field of lettuce being drilled in. The seed gangs are preceded by listers which throw the soil up in broad ridges for two rows each. Covering is done by the usual concave wheel**



Left: Working the modeling clay into the steps between the cardboard layers by hand. This produces a smooth landscape. *Right:* General view of the map showing several stages of the work. When the many contour boards have been tacked together, as shown in the left side of the picture, the jagged outlines are filled in, reproducing an exact replica of the actual landscape

Several processes in the construction of a land model

Landscapes With a Jigsaw

Making a Replica of Yosemite National Park by Stacking Up Contour Boards

By O. Van Wyck, Jr.

REPRODUCTION of the gigantic cliffs and waterfalls which have made Yosemite Valley famous throughout the world, in a space of ten feet by four and one-half, with every contour and sculptural feature modeled to scale, was the remarkable task undertaken by Park Naturalist Ansel F. Hall, of Yosemite National Park in California, when he set out to construct one of the finest relief maps ever made in this country.

After eleven months of painstaking toil the job is still unfinished, as the painting of the map in natural colors remains to be completed. However, the construction work and sculpture have been done and the map has been viewed by thousands of visitors who marveled at its perfection of detail. The story of the work has now been told by Mr. Hall for the first time and it is an interesting record of one of the most unique performances achieved by a young scientist.

"As soon as I began gathering material for the Yosemite Museum, I saw the necessity of having a relief map of the valley," said Mr. Hall. "It happened that many wonderful baskets, Indian beadwork, letters of John Muir and other museum exhibits had been donated by collectors, but we had no appropriation from Congress to purchase museum cases and furniture for the museum. So we had to turn carpenters ourselves and build all these articles. While I was at it, and because we ascertained that it would cost $25,000 to have a model of the valley made by contract, with a charge of $5,000 for each copy, I decided to make the relief map myself.

"You may wonder why, in the midst of Yosemite Valley, it was thought necessary or even desirable to have a model in clay. The answer lies in the fact that without some such aid as this almost everyone has a distorted idea of the topography of a country. Especially is this true of the Yosemite region, filled with peaks and canyons that never look quite the same from two different spots. A relief map is invaluable in teaching visitors the relation of the various natural features to one another and in assisting strangers to orient themselves when going on automobile or horseback trips or hikes. A study of this map is equivalent to making an airplane flight over Yosemite Valley and the surrounding cliffs and domes, every natural feature being shown in its proper proportion and the routes of all roads and trails being clearly indicated.

"Then, too, those who want to study the geology of Yosemite thoroughly or to inquire superficially into the fascinating geological story of how this unparalleled region came to be, can see here in miniature all the lateral and terminal moraines and other signposts which reveal to scientists what happened thousands of years ago when the first and second ice invasions were shaping these marvelous formations now known to the world as Half Dome, El Capitan, North Dome and Glacier Point. The vertical, inclined and concentric joint planes in the granite which determined the sculpture of Yosemite are represented faithfully. To actually see all these things would require miles of travel and days of effort, which the average person cannot afford to spend."

Mr. Hall stepped forward and removed a section from one corner of the map. The sight revealed was like a glimpse behind the scenes at a performance of grand opera. "Out front" one saw only the illusion which it was desired to create. Here one had before him the mechanics, the internal workings, by which the illusion was obtained.

Layers of cardboard one-eighth inch in thickness were used to build up the contours of the map, each strip in the map representing a rise of fifty feet in the actual cliff. When the protecting piece was withdrawn you saw a cavernous interior not unlike the wings of a theater, with layers of cardboard rising one above another as if someone had built an irregular staircase. This was the foundation, on which prepared modeling clay was spread for surfacing. All the minute details of the mural sculpture were worked out in this clay.

That's a brief way of telling the story—but remember that the work consumed eleven months. Mr. Hall smiles when he talks of the details over which he spent so many weary hours

"Any accurate relief model is based on a contour map," he said. In this case I used what geographers concede is the most accurate topographic map ever made—the United States Geological Survey map, known as the Yosemite Special Sheet, by F. E. Matthes. This Yosemite Special Sheet was photographed in five sections and a lantern slide in negative was made of each.

Jigsawing out the contour boards

With stereopticon lantern and anastigmat lenses, I projected each negative on a frame holding the cardboard at a distance to give the proper scale. The image of each contour line was then traced on the cardboard and the next higher contour line was indicated to show where the next layer should be tacked. The contours were cut out along such lines with a jigsaw, operated electrically.

"Having cut my contours—not all of them at once, of course, but enough to go ahead—I commenced building up the skeleton of a solid base. I used twenty-eight pounds of one-inch brads in tacking alone, which will give you some idea of the number of times the hammer was wielded before I got through. I estimate that 31,500 square feet of cardboard, cut up into little, jiggly pieces, were used for contours.

"With the cardboard representing the lower slopes in place, I had to commence modeling the surface, because it would have been difficult to do that after the layers representing the high peaks and domes were in place. Prepared clay was rubbed into place to simulate granite. When it came to putting in fine details, such as Lost Arrow, Cathedral Spires and the Overhanging Rock on Glacier Point, I used photographs to obtain accuracy, and the work was done with tools which I personally devised from mastodon ivory, centuries old, which was unearthed in Alaska. I found that clay would stick to metal and to wood, but that the stuff didn't adhere to the smooth surface of ivory. In addition, the ivory had that slight flexibility which enabled the sculptor to vary his pressure and get the effects desired."

When the clay had partially hardened a plaster piece mold was taken from which a solid reinforced plaster of Paris cast was made. Any number of such copies can be produced without injuring the original. Several museums already have asked for copies. Meanwhile, the photographs of the original will serve to give an excellent idea of the Yosemite National Park.

Traffic Signals

THE Bureau of Standards, in conjunction with the National Safety Council and the American Association of State Highway officials has undertaken a project for the standardization of colors of traffic signals. This will cover both luminous and non-luminous highway signals and related subjects.

A committee has been organized to handle this work and held its first meeting in New York City sometime ago. An executive committee was elected to administer the details of the project, and the following officers were elected: Chairman, C. J. Bennett, commissioner of motor vehicles of Connecticut; vice-chairman, M. G. Lloyd, chief of the safety section of the Bureau of Standards; secretary, W. S. Paine, Hartford, Conn., representing the National Safety Council. Three subcommittees were appointed which will collect information and data as to past practices and will carry out any investigations which may be necessary to determine the selection of proper colors and other items for traffic signals.

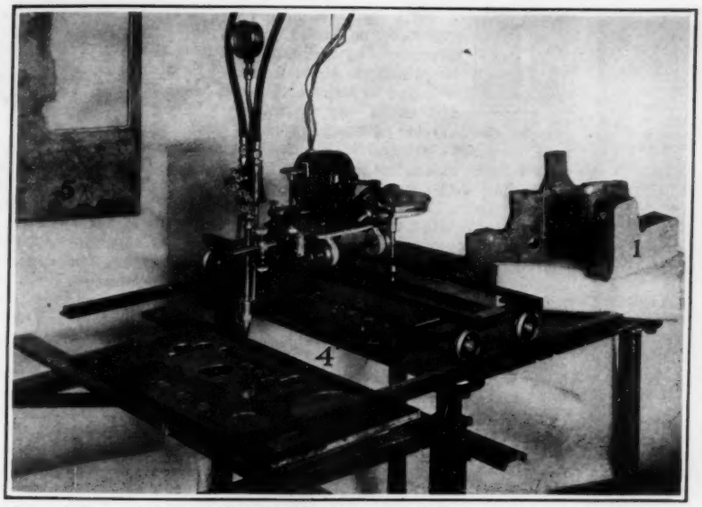
A Precise Torch Cutting Machine

BY using a cutting machine which is under perfect control, permitting a template to be followed with precision, a Boston manufacturer has brought the oxy-hydrogen torch into practical use for making dies, cams, drop forged tools, crankshafts and all sorts of special steel shapes. It is claimed that the work turned out has knife-sharp, nearly polished edges. By mounting the torch on a pair of tracks, thus giving motion in two dimensions of space, and designing a method of following an accurate template accurately, the more or less irregular, wavy line made by the hand-guided torch is given a high degree of precision.

The machine works somewhat on the principle of the common pantograph, except that it does not, of course, enlarge the outline of the template. Instead of causing the pointer to follow the template by hand, it is motor driven, and having a very carefully designed driving cone which makes contact with a special bevel on the edge of the template outline, the speed of progression along the work can be maintained at a uniform rate governed by the speed of a rheostat-controlled motor. It is really an instrument of pre cision.

The machine consists of a double carriage system, the upper carriage having four wheels running on a track. This carriage, together with its track, is mounted on a lower track running at right angles with the upper track. This permits the torch, which is carried by the upper carriage, to cover any point in a horizontal plane. The tracing system is rigidly attached to the cutting system, thus eliminating inaccuracies due to lost motion. The motor drive works through a worm gear and friction wheel, which may be adjusted as an auxiliary speed control. The tracer consists of a vertical spindle, having at its lower end a polished tracer roller which holds the driving member firmly against a bevelled shoulder along the edge of the template. Thus there is a perfectly smooth and uniform movement, the tracer following around intricate corners in an almost uncanny way without jumping or hesitation.

For the torch, oxygen is used, preferably with hydrogen and a little oil gas, such as beo-gas. Five to ten square inches of cross-section can be cut with one cubic foot of oxygen, while the speed of cutting reaches eighteen inches per minute on one-half-inch stock and seven inches per minute on four-inch stock.



An oxy-hydrogen torch mounted on a double carriage is guided over the plate to be cut by means of a tracer moved uniformly along the outline of a prepared template by an electric motor. 1: Part of trimming plate cut out of two-inch armor plate. 2: Die plate as used for trimming drop forged crankshafts. 3: Plate with various shapes cut out. 4: Fiber template with patterns for the shapes just cut out on plate at left. 5: Plate with large trimming die cut out

Automatically controlled torch which makes perfect cuts

Publications on Building and Housing

THE Advisory Committee on Zoning, which has been working with the Division of Building and Housing of the Bureau of Standards, has completed "A Zoning Primer," which explains the elements of zoning, the need, the health and property protection afforded, and its effect on the cost of living. Legal problems with an outline of what some cities have accomplished, and a zoning program are also included, among other subjects. Copies may be obtained from the Superintendent of Documents at 5 cents each. Large orders will be filled at the rate of $1.00 a hundred, or $8.00 a thousand.

A selected bibliography of zoning has also been issued. This contains critical references to the most important articles on the subject which have appeared in periodicals and books. Special sections are devoted to the arguments for and against zoning, to the legal aspects of zoning, and to such technical matters as the relation of city planning to zoning, the different types of districts, and agencies and administration for zoning. The bibliography may be obtained by application to the Division of Building and Housing, Department of Commerce, Washington, D. C.

The regular monthly report of building material prices in over 50 cities for last year, and the monthly charts showing the recent course of wholesale building material prices, have lately been issued. The chart has been published extensively in the building trade press and real estate papers.

A New Type of Electric Welded Tubular Steel Bedstead

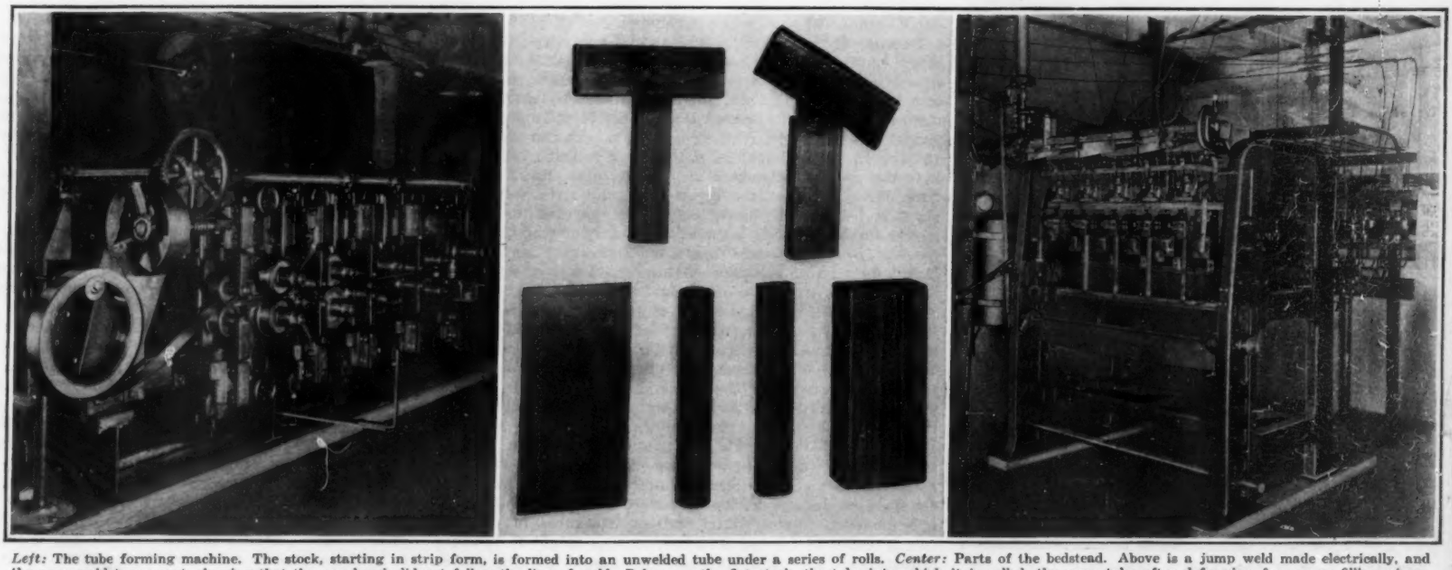
A GROUP of three machines which turn out a spot-welded steel bedstead of thin tubing every sixty seconds is the contribution to the lower cost of living made by L. C. Gale, of Waterville, Quebec, the inventor of the new process. We have bedsteads of brass tubing having a ... llarly rectangular cross-section, but these must be made by brazing each joint separately, a comparatively slow process, while the use of steel permits of welding the several filling rods of the ends of the bedstead in a single process. The welding process used, being electrical, brings about a complete fusion at the points of contact so that the several pieces become one. The point is so perfect that when torn asunder by strong force the break does not follow the line of the weld.

The beginning of the operation, which is a short, simple one, sees a roll of strip steel placed on the tube-forming machine. This strip, which may be No. 20 or as heavy as No. 16 stock, is drawn through a series of five rolls, each of which contributes to giving it the final form of a cylindrical tube.

The tubing next passes through a tube-welding machine at the rate of thirty-five feet per minute, or faster, where it is given an electric weld and thus becomes a continuous, closed, tight tube. This tubing passes through the forming machine which changes it to the shape required, in the case of the bedstead, that of a rectangular cross-section.

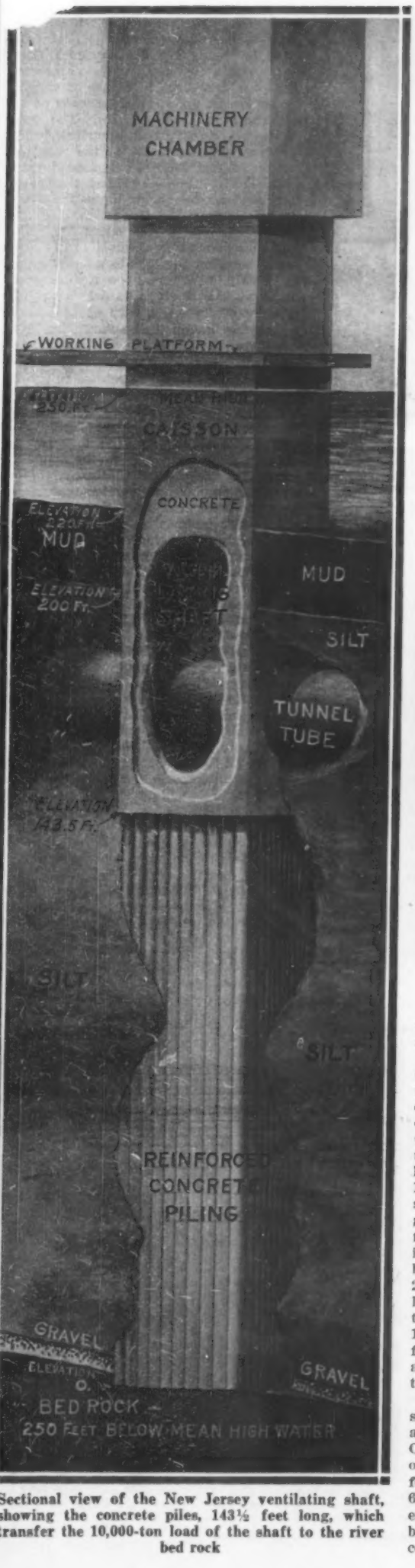
After being cut into the lengths required for making up the bedstead, the multiple welding machine joins the several vertical filling rods to the horizontal endpieces of the bed. In this process the upper ends of the filling rods and the crossrail of the bedstead are placed against their respective electrical contacts, and the crossrail is depressed by means of compressed air until it makes contact with a group of filling rods. These are burned off about three-eighths of an inch before the final push-up and fusion takes place. This whole welding process occupies about six seconds of time. The weld formed is perfectly true and geometrically accurate at the junction of the respective tubes, but an examination of the inside of the larger or crossrail tube shows that the smaller ones have been pushed into it slightly, forming a low bulge on the inside. In this respect it resembles the ordinary "jumpweld" of the blacksmith, wherein added strength is obtained by first forming a sort of cup in the flat face of one piece and jumping the other piece into this depression. That the joint thus formed in the case of the bedstead is a solid one is demonstrated by tearing the welded parts apart with a powerful force, when it is seen that the break does not follow the outline of the weld, but separates the rods in an uneven fracture, as if they were one piece, which, in fact, after the complete electric fusion, they are.

It is evident that an extensive variety of uses can be made of this process of welding, the making of economical and substantial steel tubular bedsteads being only a typical one of these processes.



Left: The tube forming machine. The stock, starting in strip form, is formed into an unwelded tube under a series of rolls. *Center:* Parts of the bedstead. Above is a jump weld made electrically, and the same weld torn apart, showing that the new break did not follow the line of weld. Below are the flat stock, the tube into which it is rolled, the same tube after deforming for use as filling pieces, and a section of the crosspiece of steel bedstead. *Right:* Multiple welding machine which welds in the entire group of filling pieces in six seconds

Various features of the production of welded metal bedsteads by a more economical and better method



Sectional view of the New Jersey ventilating shaft, showing the concrete piles, 143½ feet long, which transfer the 10,000-ton load of the shaft to the river bed rock

A Record Job of

Sinking Piles, 250 Feet Long, to Carry 10,000-T

THE civil engineer may at any time be called upon to grapple with conditions for which no parallel can be found in previous work, and which can be solved only by the exercise of ingenuity based upon acquired skill and experience. Such a problem presented itself in the construction of the massive and lofty ventilating shafts for the new vehicular tunnel beneath the Hudson River. As will be seen from the engraving at the center of this page, the tunnel is provided with four shafts. The two nearest to the entrances are known as the land shafts, and they were built for the purpose of ventilation and, during tunnel construction, for driving the tunnels. From them the excavating shields are driven in the manner described in our issue of February last. Except for their great size and the fact that provision had to be made for ventilating them, the work of driving the Hudson River tubes through the underlying silt of the river will be done upon standard and long-established lines. It is the fact that provision has to be made for maintaining the air in an absolutely sweet and wholesome condition which renders this work unique, and has centered upon it the attention of the engineering world. The introduction into the tubes of a continuous supply of fresh air, and the withdrawal of the vitiated air, will be done by means of four ventilating shafts of unusual dimensions. Two of these are being built just within the pier-head lines on each side of the river and two on the landward portions of the tunnel.

Because of the large dimensions and great weight of the river shafts, it was deemed inadvisable to rest their weight upon the tubes. Their sub-structure, therefore, has been carried down to the solid underlying rock. By referring to our drawings, it will be seen that on the New York side the tunnel intercepts the rock at a point where the river ventilating shaft on that side of the river is being built; and here the problem presented no unusual difficulties. On the New Jersey side, on the other hand, the river ventilating shaft is being built above the deepest part of the glacial gorge, through which, ages ago, the larger Hudson River flowed. Here the distance from mean high-water level to rock is 250 feet; and after passing through 30 feet of water the borings were driven successively through 20 feet of mud, 200 feet of silt, and a few feet of gravel immediately overlying the rock. It was evident, at once, that because of the enormous weight of the ventilating shaft, which is over 10,000 tons, it would have been unwise to depend upon the frictional resistance of the silt, and that to provide against any possible settlement the load must be transferred directly to the unyielding rock below.

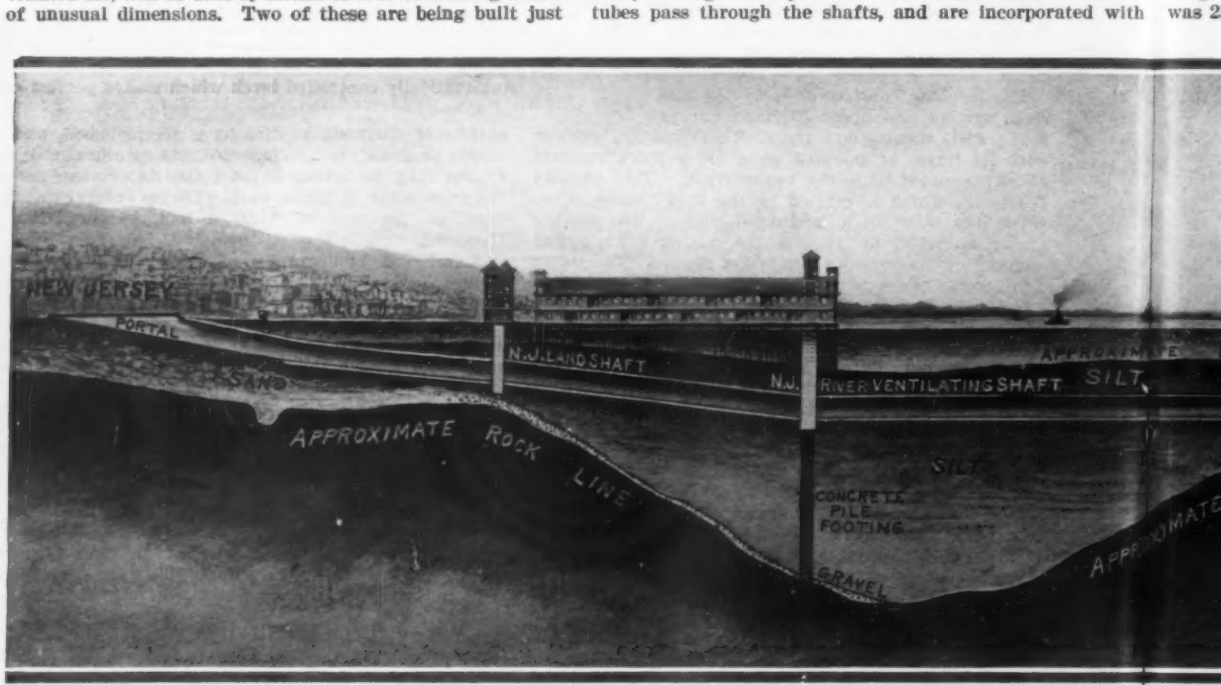
On the New York side the rectangular caisson for the shaft is built in one homogeneous structure, and its base, as we have mentioned, rests immediately upon the rock. On the New Jersey side two separate caissons will be sunk, one for each tunnel. Each caisson measures in plan 37 feet 3 inches by 50 feet 3 inches, and its height is 108 feet 6⅝ inches. The shaft is built up of steel plating, three-eighths inches in thickness, with double walls, the space between the walls, which is about 5 feet, being filled in with concrete. The weight of each shaft, including the caisson, fans, and the mechanical equipment, will be 10,000 tons. As the caisson is hollow and is of such large dimensions, its buoyancy is very considerable, being about 6000 tons, which leaves a deadweight of over 4000 tons to be supported by the sub-structure. Furthermore, since the shaft rises about 106 feet above the top of the foundation piles, and has a maximum width of 50 feet, provision has to be made for resisting the heaviest gales of wind that may blow against it; the resulting effect of such winds being an increase of pressure on the leeward side of the structure. This will result, in the heaviest winds, in increasing the total dead-load upon the leeward side by fully 30 per cent.

The bottom of the caisson extends 106.5 feet below mean high water, and consequently the sub-structure must have a total depth from the bottom of the caisson to the rock of 143.5 feet. Evidently, with a dead-load of over 10,000 tons increased 30 per cent by wind pressure, there was call for much careful planning by the engineers, if the total mass 355 feet in height was to be rendered secure, and absolutely safe against any vertical settlement. Since the tunnel tubes pass through the shafts, and are incorporated with them, it is evident that any settlement of the shafts would endanger the security of the tubes.

It was finally determined to carry the sub-structure upon a line of heavy piling, driven beneath the rectangular wall of the caisson. Each pile consists of a steel pipe with an outside diameter of 24 inches, built of ⅜-inch plating and filled with reenforced concrete. Under each caisson there are 42 of these piles, and each one has to carry a load of 97 tons exclusive of the wind loads. Since the wind load, as stated above, is about 30 per cent of the dead-load, it follows that the maximum load that each pile must be prepared to carry is 126 tons.

The reenforcement is made up of six bars which are alternately 1¼ and 1⅛ inches square. The bars are wrapped with hoops of ⅜-inch round steel, which are held in place by three vertical angles, the whole being strongly wired together. This reenforcement was built up in lengths of about 20 feet, and each length was bolted to the next by U-bolts, enclosing the square rods, each of which was lapped on the next bar to the extent of 3 feet 9 inches. Now, since these columns were about 75 times as long as their diameter, they evidently could not carry the loading of 126 tons per column without bracing, but the place of the latter is taken by the stiffness of the silt through which they were driven.

Now, to drive piling 250 feet in length, as it necessarily had to be, until it reached rock bottom, was no light task. Not only had the 24-inch pipe to be driven through 30 feet of water and 220 feet of mud and silt, but it was necessary to hold the pipe in a true vertical position during the driving. Furthermore, the reenforcement of iron bars had to be accurately aligned within the pipe, and the pipe filled with concrete and cut off at an elevation of 143½ feet above



General view of the Hudson River Vehicular Tunnel, showing the various strata below the river bottom and the position of the ve carried down to bed rock, above which the whol

ob of Pile Driving

10,000-Ton Ventilating Shafts of Hudson Tunnel

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the bottom rock, and 106½ feet below the surface of the river.

The sinking, concreting, etc., were done from a working platform which was built about 6 feet above mean high water. The pipe was first assembled in lengths of three 20-foot sections. As soon as one 60-foot length rested on the mud, it was carefully plumbed, and then the pipe was secured in two notched-out sticks of 12-inch by 12-inch timber, which were fastened securely to the working platform. These timbers acted as guides during the sinking of the pile.

Since it would have been extremely difficult, if not impossible, to drive these 2-foot cylinders through so great a depth of silt by pile-driver, it was determined to sink them by the long-established and well-understood methods of oil-well drilling, with which we are all more or less familiar. In this case a heavy spud is lowered within the pipe, and by its up-and-down action loosens up and excavates a circular hole below the bottom of the pipe. The weight of the bit which was found to be most serviceable was 2500 pounds. When the silt has been loosened up, the drilling is stopped and a bucket provided with a flap at the bottom is lowered to the bottom and the hole cleared of the solid matter. When the pipe ceases to sink of its own weight, it is assisted by using the 2400-pound bit. The drilling machine, as a rule, dug away about 20 feet below the bottom of the pipe, when another 20-foot length was added at the top and the casing was sunk to the new level. The first 80 feet of pipe sank of their own weight, and subsequently the weight of the 24-pound hammer proved sufficient with the assistance of a little tapping. When the tenth section was added positive driving became necessary, and, of course, the frictional resistance of the silt rendered the work harder as the drilling proceeded. When the last length of casing was added, it was necessary to use considerable force to drive the casing down to the rock.

When the driving was completed, it was found that some 55 feet of deposit had formed at the bottom of each pipe. This was taken out by a baling bucket, and then the interior of the pipe was thoroughly cleaned by means of a 3-inch water jet. This accomplished, the pipes were unwatered and the bottom was made watertight with a plug of fine concrete.

The "basket" of light steel reenforcement was built up in lengths of 20 feet which were clamped to each other as described above. The reenforcement was lowered into the casing by means of a heavy steel disk, from which six suspended hooks engaged the upper end of the reenforcement. The last length of the basket had to be cut to such a length that, when the whole reenforcement was lowered down to the bottom of the casing, the top of it would be at the elevation of cut-off, 143.5 feet above the rock.

The concreting of the casing was done by means of a derrick, and a depositing bucket which held sufficient concrete to fill 3 feet of the pile at each deposit. When the concreting had been carried up to elevation 143.5 feet, the 106.5 feet of pipe casing above the point of cut-off had to be removed. This was done by a large internal pipe-cutter, designed for the purpose, which consisted of a cutting-head at the bottom of an 8-inch pipe. Extending centrally within the 8-inch pipe was a 2-inch pipe, which acted as an expander for feeding the cutters against the inner face of the pipe. The cutter was operated by steam power and it took about six hours to cut and remove the upper length of a pipe. When all of the 42 piles for each ventilating shaft had been driven, concreted and cut off, the vast sub-structure, bearing everywhere upon the solid underlying rock, was ready for the placing of the caissons and the erection of the towering superstructure. We are indebted to Chief Engineer Clifford M. Holland for assistance in the preparation of this article.

Another Effort to Use Our Immense Lignite Coal Reserve

THE American lignite or brown coal area covers a large part of North and South Dakota. Since many years' efforts have been made to find a way to make full use of this source of energy, but while there is no question that the stuff has been used in a practical way, the fact remains that it has never been regarded as being in the same class with bituminous coal. That is to say, no large industries have been built up on a basis of power from lignite. Many claims have been made, and the matter has too often been a vehicle for the "shark" security salesman, but no Pittsburghs or Birminghams appear on the map of the United States because of lignite. The United States Geological Survey estimates that we still have bituminous coal enough for the next four hundred years, which will doubtless give pleasure to those who have during the past few months learned that in a pinch bituminous coal is not so bad a substitute for the much scarcer anthracite as they had thought. Therefore any method for using lignite will have to be able to compete, economically, with the cost of bituminous coal, with due allowance for the cost of transporting the latter to places near the sources of the former. It will then have to be an efficient method.

Certain experiments of lignite conducted jointly by the United States Bureau of Mines and the University of North Dakota have shown plainly that the methods of using lignite have so far been faulty in one way or another. This has generally resulted from wrong design of the ovens used for carbonizing the fuel, and in a general way from the fact that the methods used, however efficient, have been too expensive. A special oven was designed, consisting, essentially, of a vertical shaft into which the lignite, after being crushed to sizes that would pass a 1½-inch screen, was introduced at the top, and the carbonized lignite was taken out at the bottom. Carbonization, that is the driving off of the volatile contents of the fuel in a limited air supply, is analogous to the process of making charcoal. The lignite is its own fuel for this process, just as the wood billets are their own fuel for converting themselves into charcoal. About 4 per cent of the fuel was thus used in processing.

position of the ventilating shafts. The river shaft on the New Jersey side weighs over 10,000 tons and rests upon concrete piles e which the whole structure will rise 355 feet

Upper drawing: The 2500-pound drill loosening up the silt preparatory to sinking the casing another 20 feet. Lower drawing: The steel reenforcement being lowered into the casing

Writing for the Microscopic Eye

How Spy Messages are Engraved on the Head of a Shoenail

By Alfred McEwen, F.R.M.S.

Photomicrograph of the Lord's Prayer framed in the eye of a needle. Actually the engraving covers a space of 1/89,300th of an inch

THE SMALLEST handiwork of man is exemplified in the remarkable productions known to microscopists as the test rulings of Nobert, Rogers and Fasoldt and the test engravings of Froment, Peters and Webb. A test ruling consists of from 10 to 25 separate bands of parallel lines ruled on glass, with the space between the lines of each two successive bands diminishing progressively, so that while the first band contains lines far enough apart to allow only 5000 of them to one inch, the last band, of the nineteenth band test plate, is composed of 50 or more fine lines so close to one another that 120,000 of them could be ruled in a space one inch wide. These fine lines have been not only counted, but photographed, and thus actually proved to exist.

These miniature productions were well known to the microscopic world 50 or 60 years ago, but today they are comparatively rare, greatly treasured, and carefully preserved in the cabinets of microscopical societies and private collectors.

The Lord's Prayer has been cut on the large heads of special pins, and small type (one-sixth or one-eighth inch square) with faces containing the Prayer, have been cast from matrices of that size, but these objects are as billboard notices compared with a theater ticket. In the upper illustration is shown a photomicrograph (180 diameters) of the eye of a small sewing needle, through which one of the larger engravings of the Lord's Prayer may be seen. The eye of the needle, small as it is, could easily contain ten more complete prayers, written on the same scale, if ornamental frame, date, etc., were omitted.

But this is one of the "larger" engravings. Had one of the smaller "prayers" been used for illustrating it would cover the rectangle occupied by the four words "Our Father" and "Thy name," only.

The actual space used for engraving the words of this prayer measured 1/380 of an inch by 1/235 of an inch, or the 89,300th part of a square inch—in other words, the Lord's Prayer could be written on this same scale 89,000 times in a space one inch square. The smallest prayers engraved in the 1,000,000th part of a square inch or less are most difficult to prepare and fill for photomicrographs.

A good penman with specially prepared pen point will have little difficulty in writing the Lord's Prayer in a rectangle whose sides are one inch long, that is, one square inch. If, however, the sides are ½ inch long, the area is reduced to one-fourth of a square inch, and the difficulty geometrically increased. Picture the sides again reduced, this time to ⅛ inch or the 1/64th of a square inch, and the feat is impossible without the aid of some mechanical device. The use of this device, however, makes this area, 1/64th of a square inch, far too large for comfortable work, so we limit our largest product to a rectangle whose sides measure 1/100th of an inch or the 10,000th part of a square inch.

Here the layman will begin to falter, but let us try to form a conception of this small space. The shaft of the letter "I" used in the printing of this page approximates 1/100th of an inch in width. Try to imagine two of these letters crossing at right angles. Where they cross, a rectangle is formed having an area of about 1/10,000th of a square inch. Let us commence and fill that small space with writing on a scale of the size used in one of the smaller engravings above mentioned. We find a curious result; namely, after the prayer is written, only a very small part of the 1/10,000th of an inch has been used, and by a short calculation we discover that there is room not only for one or two but for 70 or 80 complete prayers of 56 words each, with a margin about each one.

Here conception fails completely, but mathematically the demonstration is quite simple, for if the smallest prayer measured by the Bureau of Standards occupied the 781,250th part of a square inch it was 78 times smaller than the 10,000th part of an inch, hence 78 prayers, with a little empty space, could easily be written in the rectangle where the two letters "I" cross.

At the bottom of the page is illustrated the reducing apparatus built for the author by the Rev. J. G. Crawford of Saunderstown, R. I., after the design of the original machine invented and used by W. Peters, a London banker, in 1852, and called by him "The Micropantograph." It comprises a base with standards and two supporting platforms on which are mounted two cooperating systems of levers, viz.; a vertical system to reduce and transmit to the diamond point the motions producing the original writing, and a horizontal system supporting the surface to be engraved. The reducing system embodies two levers suspended from substantial gymbal bearings, *R R*. These bearings act as fulcra which permit of all movement of the levers required in writing or drawing.

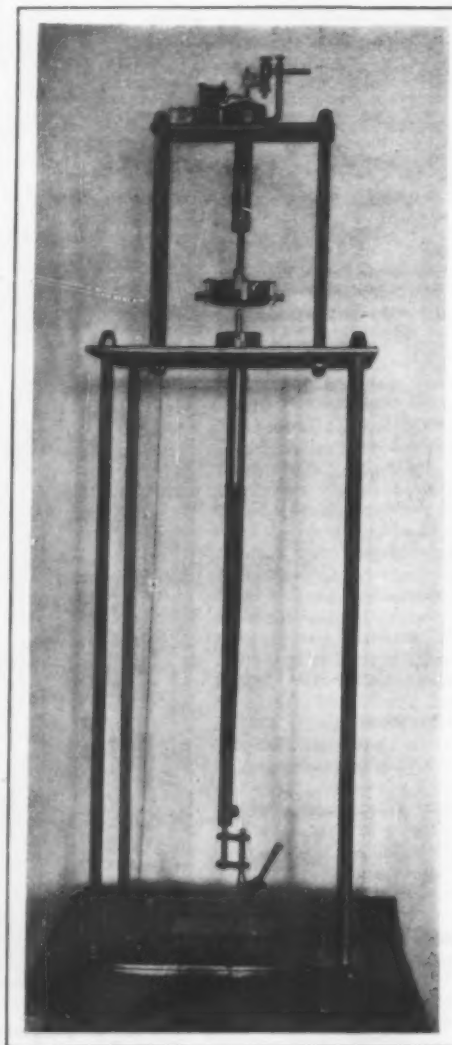
The shorter arm of the upper lever terminates in an "L" shaped casting, extending through the side of its gymbal bearing, and carrying the mounting "N" for the diamond point which should be adjustable in all directions. The lower end of the long lever which moves in an arc is equipped with a suitable pencil holder including a parallel motion connection that permits the pencil to make contact over the area used for writing. A sliding universal joint "S" connects the two reducing levers and permits the short arm of the long lever, to be increased in length or shortened, with a corresponding increase or reduction in the size of the finished engraving.

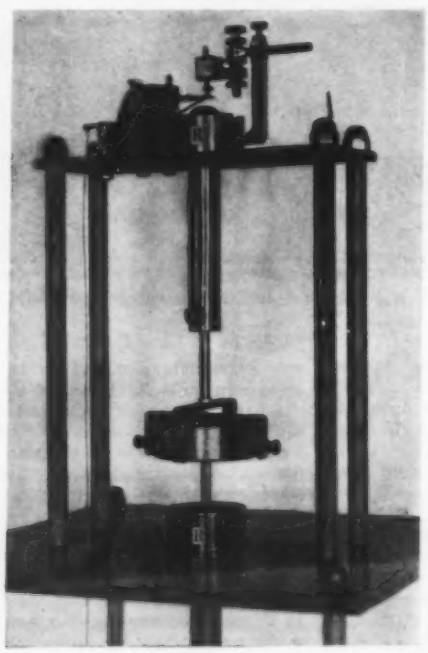
While the design of the reducing levers is comparatively heavy for the work accomplished, the recording levers require extreme lightness, and also precision of action. The upper lever of this pair is a thin plate of aluminum carefully balanced on jeweled bearings mounted in a bracket on the top platform. One arm of this aluminum lever makes contact with a fine screw that limits its motion, while the other arm extends just below the diamond point and carries a spring clamp for holding the object to be engraved (usually a small disk of thin glass). This clamp bearing end of the aluminum lever rests on a fine spring forming the long arm of its companion lever just below it and parallel to it. The short arm of this spring lever is connected by means of the fine wire "A" with an adjustable key (similar to that used in telegraphy) mounted on the base of the machine immediately to the left of the writing surface.

Depressing this key actuates, through the wire connection, the spring lever arm, which, in turn, raises the glass surface into contact with the diamond point. In this position every motion imparted to the pencil point is transmitted to the diamond and engraved in the glass or metal recording surface.

In actual operation the pencil is held at the commencement of the word to be written, the key is depressed, the word is written by the pencil, while engraved by the diamond. Pressure on the key is released, thus allowing the recording surface to drop away from the diamond, the pencil is then moved over to commence the next word; the key is again depressed, the next word is written and is recorded, and so on.

The reader no doubt wonders what is the utility of this work. The answer is, mainly for writing war time messages. When it is understood that writing can be engraved on any metal, object, jewel or imitation, such as a nail in the shoe, vest buckle, button, ring, necktie pin, etc., it will be seen how impossible it would be to thoroughly examine a suspect, who, on reaching his destination, could indicate the object and approximate position of the engraving, making its exact location and deciphering the work of only a few minutes.





The reducing apparatus for doing the microscopic engraving. It consists of a base with standards and two supporting platforms on which are mounted two co-operating systems of levers. One is a vertical system to reduce and transmit to the diamond point the motions of the original writing. The other is a horizontal system supporting the surface to be engraved. The reducing system embodies two levers suspended from gymbal bearings *R R*. These bearings act as fulcra which permit of all movements of the levers required in writing or drawing. The upper lever terminates in a casting carrying the mounting, *N*, for the diamond point. This must be adjustable in all directions. The lower end of the long lever is equipped with a pencil point holder, including a parallel motion that compensates for the arclike motions of the pencil over the writing surface

The reducing apparatus. At the left is shown the entire device. Above is the essential part of the marvelous machine

Erecting an Arch Bridge by Means of the Suspension Bridge Which It Supplants

THERE are many features of unusual interest connected with the recently completed steel-arch bridge across the Willamette River at Oregon City, Ore. In the first place, the main channel of the river at the point of crossing is nearly 100 feet in depth; and this necessarily precluded the erection of the bridge upon falsework standing in the river. This being the case, several alternate methods of erection were considered, including that which was adopted in the erection of the great Hell-Gate Span of about one thousand feet across the East River, in which the abutment piers were erected first, and the arches were then built out, section by section, the erected portion of the bridge being tied back to the abutments and to massive anchorages on shore. The plan ultimately adopted and successfully carried out, in erecting the Oregon City Bridge, consisted of using the main cables and the towers of the old suspension bridge to support the sections of the two main ribs as they were built out from the opposite shores. We are indebted to Mr. Herbert Nunn, Oregon State Highway Commission Engineer, and his assistants, for the photographs and data upon which the present article is based.

The Oregon City structure consists of a main channel arch span 360 feet in length between abutment centers, with a vertical rise above spring line of 100 feet. The shape of the arch is parabolic. The individual ribs are of structural steel and consist of a box girder section. The construction of these ribs, with their internal stiffening, is indicated in the photographs. Each rib was fabricated in 18 sections and erected, segment by segment, in accordance with the following general schedule.

The first six segments on either side were hoisted by means of a scow derrick and held in place by radial stay cables, passing upward and rearward over the towers of the old suspension bridge. The central six segments were erected on falsework bents, which in turn were supported directly by the main cables of the old suspension bridge.

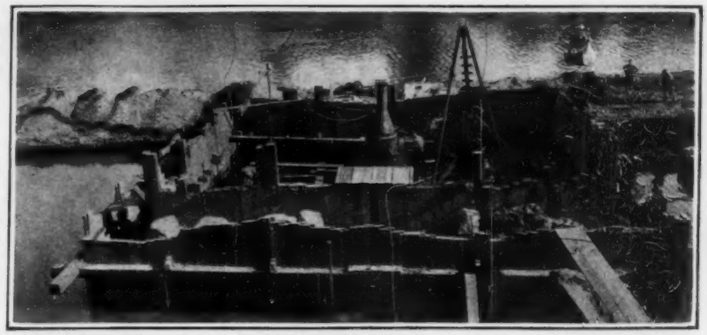
One of our illustrations shows the use of the stay cables, and also the employment of timber bents and blocking for the central segments. The nearer of the two ribs has been keyed up by the placing of the last segment; the other rib is about to be completed—its rib-segments are seen lying on the floor at the foot of the bents.

The arch rib was erected as a three-hinge arch under that portion of the dead load consisting in general of the weight of the structural steel and of the concrete floor slab. At this point in the construction, both the crown and skew back hinges were rigidly fixed; so that for the remaining portion of the dead load and for all of the live load, the structure acts as a fixed or hingeless arch.

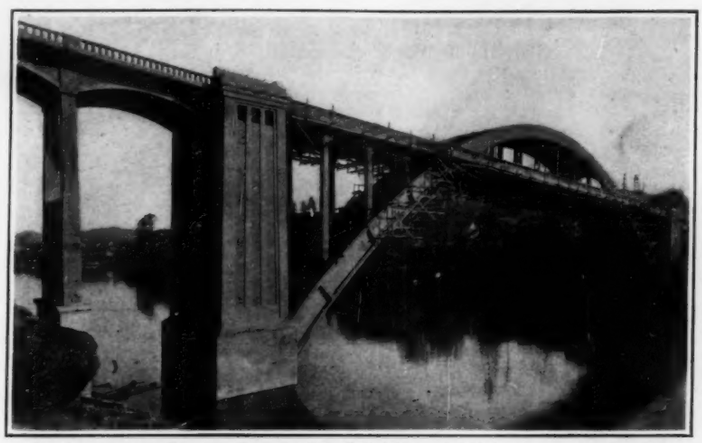
After the steel work had been erected, the columns were encased in poured concrete and the ribs encased with a two-inch protective coating of what is commercially known as "gunite," this being simply a cement mortar shot against the surface by means of a "gun" or pressure nozzle. Before the gunite was applied, small round steel bars, one-quarter inch in diameter, were electrically spot-welded to the steel work. These bars were spaced at 12 inches center to center both ways, and they thus furnished a frame work upon which was wired a complete covering of heavy wire mesh.

The center illustration shows a view of the structure nearing completion; the gunite and concrete work having all been placed, the entire structure in fact, being complete with the exception of the removal of the staging and some touching up of the concrete surface.

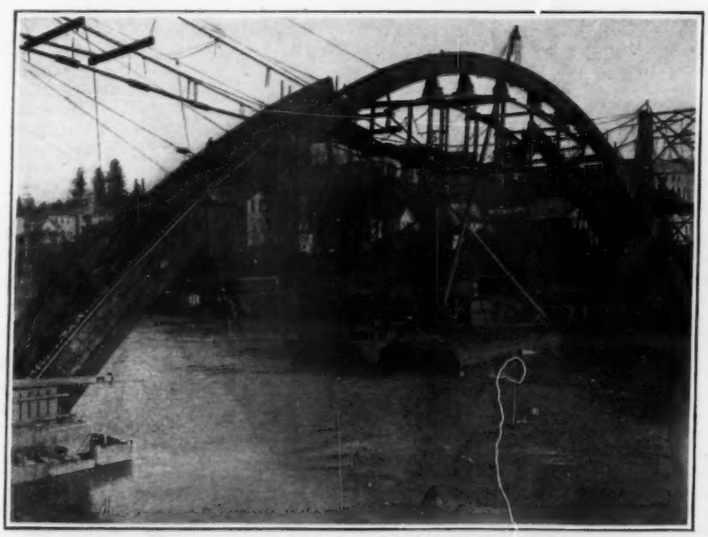
We show also a view of the west foundation cofferdam with a double wall of sheeting sunk to solid rock. This picture also shows the core-drill at work within the cofferdam making foundation explorations. Drillings were made for a distance of 30 feet into the solid rock to ascertain the presence of air pockets or cavities which would endanger the stability of the foundations. The entire structure is about 900 feet in length and carries a 20-foot roadway and two 5-foot sidewalks.



Cofferdam, with double, clay-filled walls, for building abutment in the river



Handsome new Oregon City steel arch bridge, of 360-foot span, across the Milwaukee River, Oregon



Erecting the central portion of arch by means of trestles carried upon cables of the old suspension bridge

Cocaine and Cocoa

RECENT reports that the cocaine-taking habit is increasing have started many discussions as to just what cocaine is and whether it has anything to do with cocoa, or with coconuts. Does it come from the poppy? Is there any cocaine in cocoa, corresponding to the caffeine in coffee? All of these suggestions are erroneous. The confusion arises from a similarity in names, and to the fact that cocaine, cocoa and coconuts have their source largely in South America.

First, let us dispose of coconuts. They grow on a kind of palm tree, are the size of a man's head, produce "copra," which is the commercial name for the inside of the nut before it is shredded for frosting our cakes.

Next, it is not cocaine but opium that comes from the poppy.

Cocaine is derived from coco leaves. "Coco erythoxylon" is a plant that grows in the mountains of Ecuador, Peru and Colombia. Its leaves produce cocaine if put through a certain chemical process. Cocaine is a white powder, resembling confectioners' sugar. It is taken by addicts through the nose, like snuff. It sharpens the brain and increases the courage. Criminals usually preface a big crime with a strong dose of it. They call it "snow" or "sugar."

If the leaves of the coco plant are wrapped around lime or chalk powder and chewed, a stimulating effect is felt. The native Indians of the South American mountains chew coco leaves when on a long journey or climb by foot. It temporarily keeps up their strength and enables them to go without food for a time without feeling the effects of hunger.

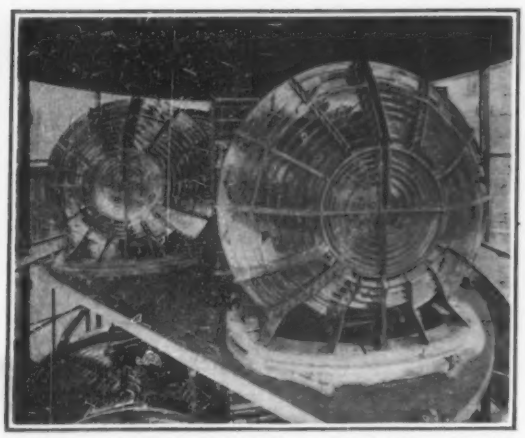
Cocoa comes from the cacao tree, which also grows in Ecuador, Peru and Colombia, as well as many other parts of the world. The tree, which is comparable in size with the average fruit tree, has pods about half the size of the coconut, and these contain its seeds. These are the cacao beans of which there are about forty in each pod. The beans are dried, roasted and ground. This makes chocolate, which is sweet or bitter, according to whether sugar is added or not. If the oil is pressed from the beans, however, the product is called cocoa.

The Limitations of Mental Measurements

MENTAL measurements have so far been developed to the point where effective determinations of general intelligence are made—determinations which are of value not only for schools and colleges, but also for commerce and industry. No psychologist claims that these measurements are completely satisfactory, and we all know that they are being constantly improved, and will be enormously improved in the future. On the other hand, no one but the psychologist knows the amount of time, labor and personal training required for the development and standardization of even the simplest test. The public, impressed by the apparent simplicity of the materials, assumes that anyone can make up a test, and the public is right so far: anyone can make up a test, and almost everyone does, but the tests are not worth anything. The public either does not see this, or, if it does see it, assumes that the tests made up by the expert are also worthless.

In addition to tests of "general intelligence" (which may most safely be defined as that which standard intelligence tests measure), tests for special intellectual capacities have been developed. We can now measure ability to sustain and to distribute the attention, ability to perceive accurately details of various kinds, ability to learn, ability to avoid learning, and many other special abilities of this class. The field of such measurements is rapidly being extended, and it now requires the application of the labor of the trained psychologist to develop systematic tests for the special combinations of intellectual abilities required in any branch of any trade or profession.

But this is the limit to which mental measurements so far have extended. Emotional and moral characteristics are not as yet measurable. Yet we know that these characteristics are of immense importance in all the divisions of life in which we are measuring intellectual capacity. Even as concerns the candidate for admission to college, while it is important to determine his intellectual capacity, emotional and moral factors ought to be known. There is many a man who goes down or barely survives in college, whose intellectual ability is sufficiently good, but who will not work, or who will get into trouble because of moral delinquency, or whose scale of values is inadequate. A number of psychologists are at work on this problem.



View of the lenses on the upper platform of the aerial lighthouse

The Aerial Lighthouse

TO mark out the Paris-Algiers aero route there is about to be constructed a "lighthouse" of extremely high power, of which we reproduce herewith two illustrations. The luminous intensity of the light will be about a billion candlepower. The equipment includes eight lenses, each subtending a full 180 degrees, at the focus of each there being a lamp consuming 120 amperes. The lenses are grouped four and four, in such a manner that the four beams are joined into one at a certain distance from the source. The other group of four is similarly arranged, but shines in the diametrically opposite direction. Each of the two beams is of a billion candlepower.

Externally the lighthouse presents the appearance of a stone tower 10 meters in height and 5½ meters in diameter, with several stories. Within, the turning parts comprise circular platforms, all mounted on a common shaft. The lenses occupy the two upper stories or platforms.

During the operation of the lighthouse no attendance is required by the lights themselves, all the controls being on the ground floor. Even the changing of the carbons in the arc lamps is done from below, by means of a system of elevators. The regulation that maintains the luminous crater at the tip of the carbon at the exact focal point of the lens is likewise done from the ground floor by means of a system of hand-operated gears, which operates by lengthening or shortening the optical focus of the system, the range of adjustment being several centimeters in either direction.

The exact position of the arc is visible downstairs by means of a sort of periscope, in which one sees at the same time a grating composed of two very fine threads that cross at a right angle, and whose crossing point indicates the exact position of the optical focus. The operator has only to see to it that the image of the arc falls upon this crossing point of the threads.

To insure an even burning down of the negative carbon, the latter is slowly rotated upon its own longitudinal axis; and this insures a very regular arc, at the exact focal point.

General view of aerial lighthouse of one billion candlepower

The lenses are placed, as we have said, upon the two upper stories. On each story they are placed in pairs, back to back; and the pairs are so arranged that the lenses on the top floor stand over vacant spaces of the intermediate story, and vice versa, in order that the control shafts may have clear passage. A system of rheostats placed near each lens permits the exact regulation of the voltage absorbed by each lamp. The lenses themselves are of the echelon style customary in lighthouses; each is 1.8 meters in diameter.

The rotation of the ensemble is effected by a small electric motor located under the platform of the second story. The pinion of this motor engages a circular rack on a central column. The rotating group rests upon a bed that rises through the center of the ground floor; and the bearing is through a mercury bath as is usual in lighthouses.

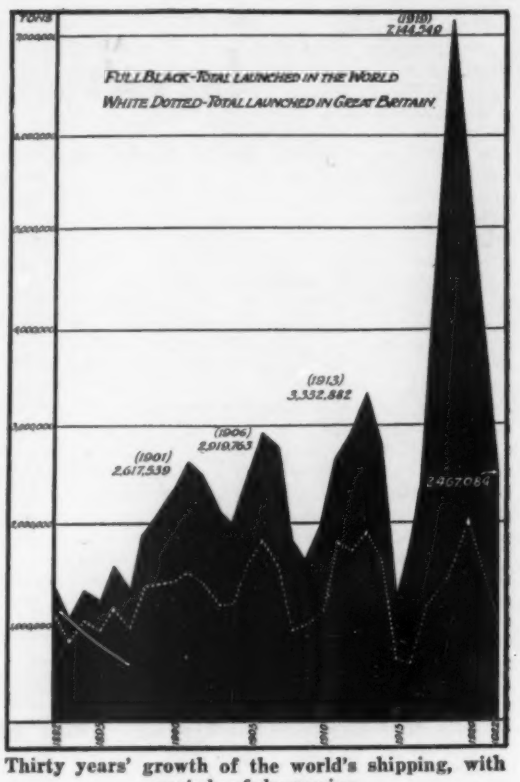
The large number of lenses used presents the advantage that in the event of an accident putting one lamp or one lens out of commission, the intensity of the beam on the side affected is decreased only by one-quarter, and that of the other beam not at all. The manufacture of eight lenses of moderate size is again much simpler, quicker and cheaper than that of two of unreasonable diameter.

The lighthouse is now actually under way in the factory of the constructors, and will shortly be ready for erection. It will stand on a hill 10 or 12 kilometers from Dijon. The beam will be visible in clear weather for a distance of 300 kilometers and in average weather for 150 kilometers.

Growth of World's Merchant Shipping

THERE is much interesting world history, particularly as it affects the high seas, to be found in the accompanying diagram showing the gross tonnage of merchant vessels launched throughout the world during each year from 1892 to 1922. Upon our diagram, which, with its totals of shipping, is based upon a diagram recently published in the *Shipping World*, is a broken white line, which shows the total amount of shipping launched in Great Britain and Ireland year by year during the same period.

We draw attention to the fact that the curve is not regular but is marked by high peaks and low depressions which, during the present century, have occurred approximately at six-year intervals. Also note the rather close correspondence of the British output of ships with that of the total for the world. An exception is found in the year 1920, which is to be explained by the huge output of ships in the United States in response to the war's demand. The impulse of our war building began in 1917 to 1918, and the launchings reached their highest peak in 1919, when the output for the whole world totaled the enormous figure of 7,144,599 tons. It will be noticed also that the decline in the world's output to date was at nearly the same rate as its increase.



Thirty years' growth of the world's shipping, with periods of depression

The Evolution of the Earth-Moon System

IN a lecture delivered before the Geological Society of London on November 21, 1922, Prof. A. S. Eddington says, regarding the question of the evolution of the earth-moon system:

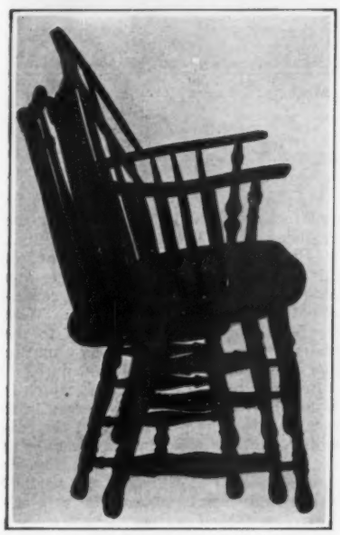
"After the evolution of the solar system, we naturally turn to consider the evolution of the earth-moon system. My impression is that nothing in recent progress suggests any doubt that the beautiful theory of Sir George Darwin is substantially correct. The main features are that the moon at one time formed part of the earth, and broke away. At that time the rotation period of the earth was between three and four hours, and the cause of the fracture was that the solar tidal force synchronized with a free period of natural vibration of the earth; owing to resonance the tidal deformation of the earth continually increased until rupture occurred. The earth's period of rotation has since lengthened to twenty-four hours, owing to frictional dissipation of energy by lunar and solar tides; and the back-reaction of the lunar tides on the moon has caused the moon to recede to its present considerable distance. All this has well stood the test of searching criticism, and must be considered as extremely probable. Modern research has added two contributions; it enables us to calculate the magnitude of this tidal friction at the present time, and it enables us to locate more exactly the region where the frictional dissipation is occurring.

"I believe it was Darwin's view that the tides most potent in wasting energy were not water-tides but tides in the solid earth; that is to say, we have to do with deformations of the whole earth under the tide-raising force of the moon's attraction. Undoubtedly these deformations of the earth occur, but everything turns on whether the process of deformation is attended with serious friction. H. Jeffreys has pointed out that the phenomenon of latitude variation is accompanied by similar deformations of the earth; and in this case it is clear that the friction is inconsiderable, for otherwise the deviations of the pole from the symmetrical position would be damped out almost at once. It seems, therefore, very unlikely that the solid tides can have had much effect in the process of tidal evolution of the earth-moon system. Ocean tides are likewise of small effect as Darwin himself had seen. The modern conclusion is a very curious one; it is in the land-locked shallow seas that nearly all the mischief occurs. This was discovered by G. I. Taylor, who found that the Irish Sea alone is responsible for one-fiftieth of the whole amount required by observation. The remaining land-locked basins on the earth are probably capable of making up the necessary total.

"The actual rate at which the earth's rotation is being slowed down at the present era can probably be deduced with fair accuracy from the records of ancient eclipses. The day is lengthening about one-thousandth of a second per century or a minute in 6,000,000 years. At this rate we should have to go back more than 10,000 million years to the time when the day was between three and four hours and the moon was born. Since the rate depends on the accidental circumstance of occurrence of shallow seas no definite prediction can be made; but allowing for the much greater effect of the tides when the moon was nearer to us, it is difficult to date the birth later than 1000 million years ago."

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News



Space-saving trio of chairs

Conserving Cubic Inches

WHEN you live in the country one of your initial troubles, especially if you are just embarking on a married career, is to find furniture enough to fill your room space. But if you suddenly get the urge to pull up stakes and move to the great city, your troubles will quickly assume the form of disposing of things you thought you needed, but have no room for. You quickly become aware that things have to be combined in some manner, if the janitor is not to be the unexpected recipient of some of your most cherished but space-hungry possessions. Three chairs that nest as one will be such a saver of cubic inches that there may be room left over for that big sofa you shipped down, "because it would go so far in furnishing an apartment." Of course, these three Windsor chairs, which are made in San Antonio, Texas, are not of the same dimensions, but that adds to the charm of them. When they are nested their individual sizes are a matter of indifference; disassembled, when the family floats in from the old town there will be a chair for each of the "kid" brothers and sisters, exactly fitted to their size.

Revolving Brush to Clean Combs

PICKING the teeth of a comb with a pin is a tiresome process that can be avoided by using a special brush made for this purpose by a Chicago brush maker. A strong, stiff-bristled little brush revolves on a handle and may be very quickly run over the teeth of a comb, removing dandruff or oil that may have lodged there, as well as numerous hairs that become packed between the teeth. The little brush is made so that it is easily removable from its handle for washing.

Revolving brush quickly cleans comb

This Gage Is Used in Measuring Tapers

A GAGE which, it is claimed, provides a quicker and more accurate means of measuring tapers than anything else ever devised is the product of a New York manufacturer. The gage is a double sine-bar and angle-measuring gage for use in originating tapers and for duplicating tapers already in use. The device consists of steel parallels mounted on angle bars, which are pivoted on pins set in a base plate, and operated simultaneously by means of an adjustment screw, the bars being secured immovably in position by locknuts when the taper has been established.

To set the gage, reference is made to the figures on a chart so as to secure a figure twice the size by one-half the angle. Adjusting the gage by turning the knurled nut until the specified micrometer reads across the one-half inch movable measuring pins is the next step. This gives the correct taper for each foot and also the measurement of any desired taper, from 0 to 4 inches per foot.

Drinking Coffee, Not Chemistry, for Breakfast

SCIENTISTS and bacteriologists now claim we should use no metal in making our coffee. Our favorite morning brew undergoes a chemical change when in contact with metals, leaving a thin deposit on the latter, as well as on the inside of the stomach, that is not good for us. Moreover, the pot should not be boiled, it seems, for this favors the chemical change in question very greatly.

The tricolator provides hygienic coffee

Toughened coffee topers will pass up the science and continue to drink the coffee as of old, leaving the younger generations to adopt such beneficial arrangements as the one illustrated, which, being porcelain, avoids the deleterious coating. Moreover, it has a framework of wire which is intended to hold a square of cheesecloth, into which the ground coffee is placed and brewed on the "tricolator" principle. For this process the water trickles through the coffee without remaining too long on it. As it uses less coffee it cuts down the high cost of living—by only a little, perhaps, but every little helps.

A Weeder and Rake in One

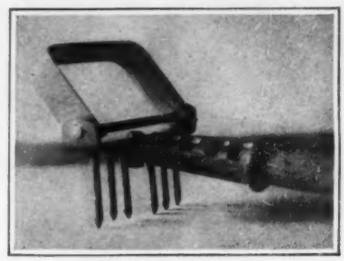
THIS handy tool is unexcelled for weeding and cultivating under shrubs, bushy plants and flowers. The long six-foot handle enables the operator to work in a natural upright position, saving labor and backache. The double-edged rocking blade cuts either when pushed from or pulled toward the user, destroying weeds and loosening the earth. It lightens and levels the soil and forms a perfect mulch. It is superior to the hoe for general work, because you back away from your work instead of walking over it and tramping it down. The weeder also does the work of a rake, cleaning the ground as you work, without changing tools. It really looks as though this were a tool that should be in every garden.

Device for measuring tapers

The Electrodynamic Receiver

THE public and commercial history of the electrodynamic receiver is very interesting. The inventors could have done no better when they called the device the "great voice," deriving the name magnavox from the Latin words magna and vox. It is truly the great voice and has had a profound influence in public affairs during the last few years. Its initial bow to the public was made Christmas Eve, 1915, at the Municipal Christmas Tree Celebration at San Francisco, Calif. That it fulfilled the expectations of the inventors may be fully realized in the words of the San Francisco *Bulletin* of the following day: "The slender tone of a single violin plainly heard a mile away; Tetrazzini's voice on a phonograph record resounding from end to end of the vast stadium; the words of Thomas W. Hickey reading Lincoln's Gettysburg address reverberating like the roar of a giant; a piano solo resembling the chimes of Westminster Abbey, played by a Colossus of Rhodes—these things are made possible by the new invention."

After this first demonstration, attended by 50,000 people, the electrodynamic receiver has officiated at nearly every large gathering of public importance since the war, where speakers needed amplification of the voices. During the war no demonstrations were made because of the great pressure of Government orders in the factory. Several notable examples are as follows: Ex-President Wilson spoke at San Diego to 50,000; at Reno to 6,000 in three different theaters at the same time. The Prince of Wales spoke to 30,000 also at San Diego. The Victory Loan was opened by an aviator delivering a speech by radiophone and magnavox to 30,000 at Washington, D. C. President Harding and his political opponents used the electrodynamic loud speaker constantly in the 1920 campaign to talk to crowds varying from 40,000 to 100,000 in the case of ex-Governor Cox at Sheepshead Bay. Many other instances may be cited where this apparatus has made it possible for a single speaker to address enormous crowds.



Handy garden tool

The electrodynamic principle involved in the construction of these loud-speakers is perhaps the only satisfactory principle by which a loud-speaker may be constructed to give great volume from one instrument. There is practically no limit to the sound which can be given off by the electrodynamic receiver, and this volume of sound is directly proportional to the input of modulated voice current. At present the instrument will satisfactorily take care of 10 watts of power through the movable coil and would take care of more if an amplifier were built to give more than this amount in its output. With 10 watts in the receiver coil, however, an individual has no trouble in speaking well over a mile distinctly and can talk to as many people as can conveniently assemble. Both with reference to the addressing of huge outdoor crowds, and to the distribution of a discourse to a number of indoor audiences, it seems that the magnavox is to revolutionize the technique of public speaking.

Masking a Broom with a Dustmop

INSTEAD of having a separate dustmop with a long handle of its own, a mop maker of Quincy, Ill., has hit upon the idea of providing one that has a cloth sleeve attached. By means of a tape this may be quickly attached to an ordinary broom, and thus dusting in out-of-the-way places is made possible.

When a broom becomes a mop

Simple pull removes dustcap

It is said to contain no chemicals and to be as usable wet as dry. It is simply a mop, minus a handle.

Time Saving Dustcap

A DUSTCAP for automobile tire valves which does not have to be turned and twisted for several minutes has been developed by an Illinois manufacturer. A specially constructed nut screws down over the tire valve stem and the cap is pressed on to it. A strong spring enclosed in the cap makes it possible to remove the cap with the action of pulling up on it, and pressing down on the cap replaces it so that it cannot be jarred loose. On every ground this seems an improvement over the dustcap of conventional type, with its familiar necessity for wrestling with a wrench.

Anchoring the Rug

A RUG anchor is the latest device for preventing rugs from slipping and causing accidents. Injuries have become so frequent from this cause that one of the important accident insurance companies reported recently it had paid 1225 claims, amounting to over $100,000, for such injuries.

The rug anchor consists of a material 54 inches wide with a dull black surface on one side embossed with a fine grain. This side which is heavily coated with a special compound lies next to the floor. The other side is simply a good looking whipcord. When laid upon the floor, the weight of the material—about three pounds to the lineal yard—holds the adherent, air-excluding compound to the floor with a suction grip that prevents all sliding or wrinkling. The rug or carpet is laid upon the rug anchor, cloth against cloth, which eliminates all danger from slipping.

It is stated to have the added advantage of not disfiguring the floor and it can be moved with the rug to any part of the room.

A Car Stop Sign is Combined with this Line of Strain Insulator

AN interesting combination of line and strain insulator with a car stop sign has been developed by an East Liverpool, Ohio, manufacturer. The device is constructed from the same material that high voltage insulators are usually made. It has the advantages of showing up clearly and distinctly at all times as smoke and dirt will not readily adhere to its highly glazed surface.

Strain insulator includes car stop sign

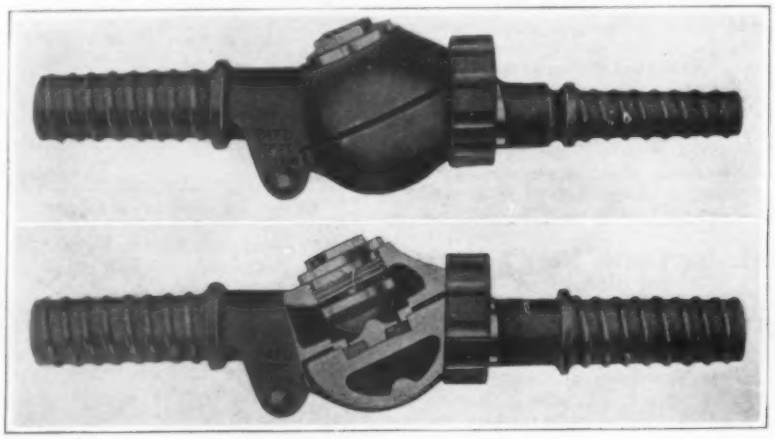
Convenient Air-Hose Coupling

FOR shortening or lengthening air hose lines or removing air tools a Muskegon, Mich., manufacturer has developed a coupling which also acts as an automatic check-valve. As a result, it is possible to dispense with the valve at the pipe line. Or, if such a valve is retained it is possible to remove a tool or insert a length of hose without shutting off the pressure on the line, as has heretofore been necessary.

In making a connection, kinking of the hose is eliminated because no turning movement is necessary, the two halves of the coupling simply being clamped together. The half containing the check-valve has a machined face, and is so constructed that the pressure of the air in the line comes against the top of a brass stem having a leather disk valve facing. The valve stem is centered by a reamed hole in the valve cap. Two projections with a cross bar extend beyond the face of the valve seat, their purpose being to protect the seat when the valve half is dragged along the floor at the end of a hose, as so often happens in the use of this apparatus.

The hose-shank half has two small projections beyond the valve face, and these push the valve open when the connection is being made, thus admitting pressure to the new section of line. This part has a gasket let into a recess, where it is permanently cemented. An eccentric clamping ring locks the two halves together.

In coupling pipe or hose the half having the hook is hooked under the pin of the other half, the halves are pushed together and clamped with the eccentric ring. No air need escape, even at any pressure, while this is being done and little strength is needed to push the halves together. The increased convenience, as compared with pre-existing models, is obvious.



Air hose coupling acts as checkvalve

A Non-Magnetic Cast Iron

A DEMAND has existed for a long time for a metal having non-magnetic properties similar to brass and gun metal, but in price more nearly approaching that of cast iron. As the result of a series of exhaustive experiments by a British chemist and foundry manager, a non-magnetic cast iron has been invented and patented which is being manufactured in England under the name of "No-Mag."

It is described as an alloy possessing not only the features of gun metal which are essential in the design and construction of electrical machinery, but also having a higher specific resistance than ordinary cast iron. Such a metal may well have a revolutionary effect in the construction of electrical apparatus as its use eliminates magnetic hysteresis and the losses due to eddy currents are reduced to a minimum. It is stated that these advantages are not jointly obtainable with any other alloy or metal in commercial use.

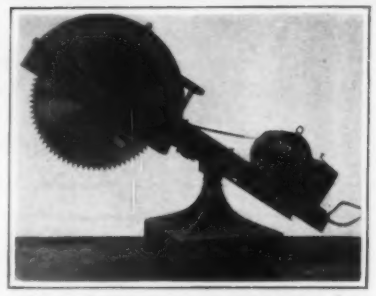
This new iron can be cast as easily as ordinary cast iron, brass or aluminum and has the same appearance as the former with which it compares also equally as regards strength and machining properties. In tensile and transverse strength it follows the usual figures for cast iron, but it has the further advantage of increased toughness and malleability.

The cost of "No-Mag" is, as with other irons, reported as dependent upon the type of casting, but it may be taken as being from 20 to 50 per cent higher than ordinary gray cast iron. Compared with the price of gun metal, its advantage as a substitute is obvious economically. Among the applications of the new cast iron may be mentioned oil switch covers, bus-bar clamps, brackets, cable boxes, sealing bells, bearing covers, separating pieces, transformer covers, etc.

An Odorless Ash Can

ONE housewife of our acquaintance states that the most distasteful detail of her kitchen work is emptying kitchen refuse into the garbage can, especially in summer when a swarm of fruit flies rises from the opened can and make more noise by their presence than the odors that rise from it. There ought, she says, to be some kind of an invention to rob this task of its unpleasantness. Therefore if she is typical in this matter of half a nation of similarly plagued housewives, the answer will be given her in terms of just such an invention, which is being put into form by a New York manufacturer of garbage cans.

The creation consists of a kind of double doored trap which is placed on top of the regular cylindrical can. First the lid is raised and the refuse is thrown into the attachment. Then the cover is replaced. Following this, the pressure of a small handle discharges the contents of the top into the can below. The particular merit of the invention lies in the fact that you do not open the large compartment where the matter finally lands until you have closed the upper compartment, and therefore no odors escape from the garbage which presumably has lain in the can long enough to be disagreeable to smell and see. Moreover, the double vestibule doors make access by the housefly and tiny fruitfly impossible.



Motor-driven saw for quick work in lumber yards

A Portable Cut-off Saw

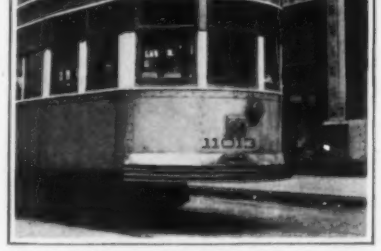
A CROSS-CUT saw which is mounted on a miniature railway and can be used in any part of a lumber yard is the product of a German manufacturer. This saw, whose usefulness in a yard of this sort would be great, may be run about on a very light and easily removable track made up in sections. With logs or timbers stacked parallel to the system of trackage it is an easy matter to make cuts of any desired length.

In order to operate the saw, which is motor driven, all that is necessary is to turn on the power by means of the controller, and by elevating the handle at the back of the frame, to lower the saw into the work. A clamp on the vertical axis permits the angle of cut to be adjusted, so that if necessary, oblique cuts may be made. A pair of stop screws is provided to limit the depth of penetration, if desired. A handbrake, controlled by a handwheel, permits of locking the saw in any position along the track. The saw is protected by a perforated sheet metal apron, and can make cuts of any depth up to about sixteen inches.

Street Car Stop Lights

ACCIDENTS have frequently occurred because street cars have stopped suddenly and the motorman of the car following or the driver of an automobile just about to pass did not realize the fact soon enough to prevent a crash, or to avoid some passenger alighting from the car.

The danger of such a happening is practically eliminated by the installation of stop-lights on the street cars. These are very similar to the ones so much in use on automobiles, but are "built in" as an integral part of the car. As shown in the illustration, they consist of two lights side by side, one of which is red and the other green. As long as the car is moving ahead under power the green light burns, but as soon as the power is shut off and the brakes applied the green light goes out and the red one shows its brilliant warning, continuing to burn as



The familiar automobile rear stop signal on Detroit street cars

The smoke goes up the chimney, but the heat stays in the room

long as the car stands. As soon as the car starts the red light goes out and the green one burns again.

A More Efficient Stove

IN the ordinary type of stove the strong suction draft from the smoke pipe draws the flame, heat and hot gases from the sides of the stove and compels them to make a hurried exit up the flue. Much of the heat is lost. Therefore a new type of stove which is made in St. Louis should be able to make its way as a fuel saver and heat giver. The appliance which makes this possible is a double baffle plate consisting of a lunette of iron placed horizontally across the upper part of the fire box, combined with a vertical plate riveted to the latter. The two plates force the gases from the fire towards the sides of the stove, where they give up their heat before they have passed out of the smoke pipe. For the same reason there is much less risk of fire, the smoke pipe being at all times much cooler than in the case of the ordinary stove.

Bearings of Limestone

IT has been reported from Germany that limestone bearings have and are being used with great success on railroad cars and other pieces of apparatus wherein the bearings work under high pressure. It is known that the proper construction and lubrication of the bearing are essential factors in the efficiency of the operation of the machine. Effectively lubricated bearings not only reduce the wear on the steel shafts but diminish the energy lost in friction to a minimum.

The limestone bearings are made with a white metal casing, that is, the white metal is poured in a mold around a solid piece of limestone, which is tightly joined to the metal. Then the limestone core is bored with a diamond point tool, so as to form an opening for the introduction of the shaft. The oiling of the bearing can be accomplished in any of the different standard methods of lubricating bearings. The limestone, being a porous substance, absorbs and holds the oil. Perfect oiling is secured, for the surface of the limestone is always lubricated and the heat generated by whatever friction does take place serves to cause the oil, already absorbed by the limestone, to ooze out and perform its lubricating function. The consumption of oil in this type of bearing is considerably less than is customary with the regular type.

The friction between the steel shaft and the bearing soon confers a high polish on the limestone surface, with the result that friction is reduced to an absolute minimum. This promotes the life of the bearing and reduces the loss in energy during power transmission. This is indicated by certain tests which were made on railroad and street cars, provided with the regular type of bearing and the limestone bearing. The former lasted for from 6,000 to 7,000 miles while the latter gave good service for from thirty-five to forty-five thousand miles.

Automatic switch lowers this light when you forget

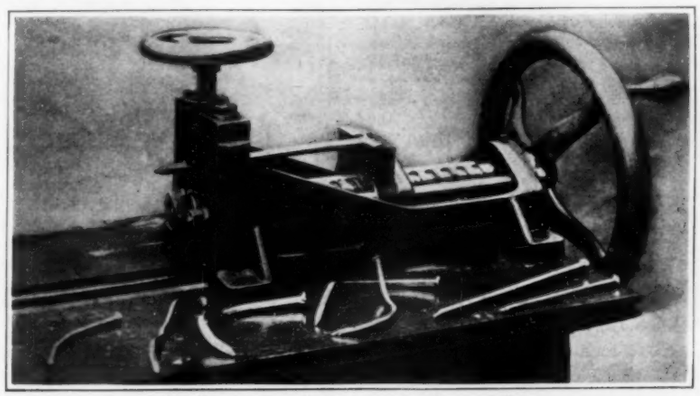
A Vacuum-Actuated Windshield Cleaner

IN an attempt to get around the use of the pressure piston for moving the squeegee of an automatic windshield cleaner, a Chicago manufacturer has put on the market one that works by means of a vacuum. It is claimed that this does away with packing and gaskets, as well as the loss of power that goes with leaky joints between the piston and cylinder walls. In this case a pair of rubber cups is used and as these are permanently bound to the metal cup that takes the place of the cylinder, the action of the apparatus involves flexing the rubber cups in and out, alternately. The operation is practically without friction.

The squeegee on the front side of the windshield may be adjusted by means of a thumbscrew on the inside, so that if it becomes stuck or if it rubs too hard it can be manipulated instantly.

Features of Straight-Eight Engine

SO much has been suggested and reasoned concerning the fundamental principles which led to the recrudescence of the eight-cylinder-in-line engine for racing purposes that it is most interesting to learn the views of those engineers in France who sponsored the movement. The straight-eight appears to have been adopted because it is well balanced; allows of a higher number of revolutions than is possible with four cylinders of equal displacement; because the lighter reciprocating parts, such as valves, though multiplied in number, are less highly stressed, and hence should prove more reliable, and because with this design cooling, in the sense of the avoidance of distortion, is more thoroughly effected. Other engineers, however, are very definite in their preference for the large cylinder on the score of the possibility of lighter construction. In Europe, one group seems to favor the large soft engine, characteristic of so many American cars, with its top-speed capabilities, while the other would embrace the high-speed engine and the four-speed gearbox, which is common to British medium-power car design.



In Germany, nails are scarcer than marks

Straightening Bent Nails

THE Germans are evidently learning thrift, as evidenced by this photograph of a machine for straightening used and bent nails, which was sent us by a German correspondent. The device consists of a bedplate on which is mounted a long screw, which is designed to force the nut through which it is inserted to follow rapidly along a pair of guides as the screw is turned by hand. The nail to be straightened is thrust through an adjustable clamp and dropped into a notch in the top of the nut. When the crank is turned, the nail is drawn through the clamp and comes out perfectly straight. Nails and spikes up to 12 inches in length may be salvaged in this manner. Ordinarily it is held that it is not worth the carpenter's time to pick up a dropped nail, much less to straighten bent ones. Perhaps the necessity of going to all this trouble to salvage old nails indicates that the Germans are in straightened circumstances themselves; or at least, if not "broke," they are badly bent.

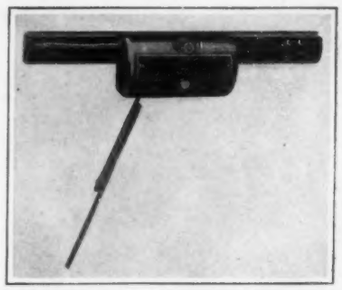
A New Spotlight

WHEN this new spotlight, which is made in Los Angeles, is left tilted up at such an angle that it violates the law regulating the height of such lights, it automatically foils the police summons by nodding its head downwards until the legal angle of the beam is reached. All this is done by a small plunger switch which is built in with the bracket which supports the light.

A New Steering Gear

A NEW gear which is radically different in principle and design from any other steering gear has been put on the market by a Lafayette, Ind., manufacturer. Though small in size and simple in construction it offers, according to its sponsors, a more powerful leverage than the ordinary screw and nut type of steering gear.

The actuating member is a cam, very similar in appearance to a single thread screw of variable pitch, mounted between ball bearings which take both thrust and radial load. The cam is connected by means of a serrated, splined joint with the steering tube, at the upper end of which the steering wheel is attached. When the steering wheel is turned, the cam turns in its bearings. As the cam turns, the diamond stud projection on the inner side of the lever and in contact with the cam, moves up or down, the lever rotating the trunnion shaft, which is pivoted in the sides of the housing. The lever is a projection from the trunnion shaft. When it rotates, the trunnion shaft and the steering arm at the other end of the shaft rotate and transmit the steering action to the wheels.

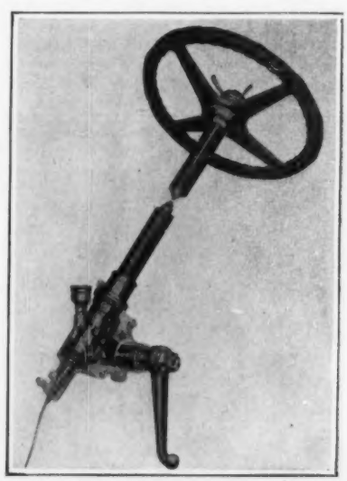


Suction takes the place of pressure

As will be noted from the illustration, the cam is machined with a thread of variable pitch. In mid position, there is very slight pitch and the motion is slow, but as the pitch increases, the motion increases constantly and rapidly toward either extreme. When the car is driven straight ahead, the low reduction of the gear in mid position practically eliminates all road shock. When rounding a corner, a very little turn of the wheel is required as the ratio becomes constantly faster, the further the wheel is turned.

Without increasing the weight or size of the gear, the lever arm inside the gear is very long, giving remarkably easy steering and long life both to the cam surface and the diamond stud which moves upon it. The longer the arm, the less pressure is exerted on the contact surfaces.

It is claimed that the gear is so irreversible that the driver does not have to fight even the roughest road, while practically no road shock is felt in the steering wheel. It has been held by some engineers that if the steering gear operates too easily, the car will not hold the road well, but this new cam and lever steering gear offers the easiest kind of steering. At the same time, the car will hold the road with the least effort on the part of the driver. The accelerated action in turning corners is a highly de-



Steering wheel employs cam with variable-pitch thread

A water-cleaned spectacle lens

sirable feature. Motorists will also appreciate the value of this feature when swinging their cars back into flat-to-the-curb parking position.

Non-Fogging Gasproof Glasses

THOSE who wear special goggles as a protection against gases in industry, and especially those who wore gas-masks in the war, will appreciate a new self-cleaning lens which has been placed on the market. The device consists of a pair of double lenses between which is a space filled partly full of water. Normally the wearer does not look through this film of water, but when the glasses become fogged it is only necessary to shake the head, splashing water up onto the lens, thus cleaning it.

Vacuum-Cleaning the Cotton Plant

IN an effort to discover a way to cope with the cotton boll weevil which has now spread over practically the whole of the cotton producing region of the United States, the Department of Agriculture has established in Louisiana a laboratory for the express purpose of testing new methods of attacking that highly expensive cotton-field pest. This station is known as the Delta Laboratory of the United States Bureau of Entomology of the Department of Agriculture, and to its staff have been submitted hundreds of ideas for controlling the weevil. Many of the ideas have been of evident value, although as yet no method of control that depends upon a machine has had such a phenomenal success as to stand out as a perfect remedy for the trouble. Many other ideas which were submitted were obviously too impractical for adoption, yet so great is the damage done by the boll weevil, and so strong is the threat of destruction to our second most valuable crop, or of its reduction to a minimum, that every plan contributed, no matter how apparently trivial, was given consideration.

A machine for collecting cotton boll weevils

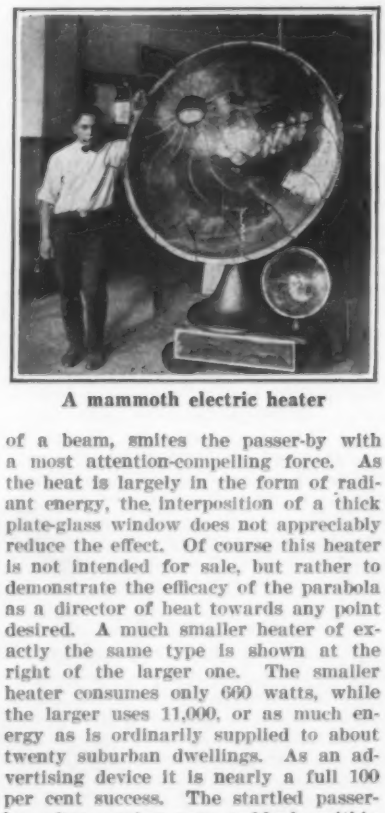
One of the methods of coping with the weevil is to poison him—or "her," as we are told by the entomologist, who asserts that "the female is the most deadly," etc.—while another method which has met with good results is that of simply collecting the beetles themselves. The machine illustrated is for this purpose. Made by a Lincoln, Nebraska, manufacturer, it consists simply of a wagon-frame on which is mounted a powerful air-suction fan direct-connected to a four-horsepower gasoline engine. Beneath the fan is an opening having two wings or sides which are designed to straddle the rows of the cotton plants. As the machine is drawn by a team of horses along the rows, the weevils are sucked up by the powerful fan, and when a bushel or two of the bugs has been collected they receive the direct vengeance of the cotton grower.

An Inexpensive German Holiday

MANY are the forms which the present situation in Germany has brought out for getting around the high cost of luxuries in Germany. Here is a couple who carry their Rolls-Royce on their feet and its motor behind them. The former is a roller skate made up of two light wheels, with the addition of a mud-guard. The latter is simply the well-known skate sail. A vertical brace extends from the chassis of the skate to the knee of the wearer, to prevent turning the ankle.

A Giant Heat Ray

AN immense electric heater of the bowl or reflector type has been on exhibit in the display rooms of a New York dealer in electrical supplies. This giant bowl throws out eleven kilowatts of energy, or about fifteen horsepower, which being concentrated in the form



A mammoth electric heater

of a beam, smites the passer-by with a most attention-compelling force. As the heat is largely in the form of radiant energy, the interposition of a thick plate-glass window does not appreciably reduce the effect. Of course this heater is not intended for sale, but rather to demonstrate the efficacy of the parabola as a director of heat towards any point desired. A much smaller heater of exactly the same type is shown at the right of the larger one. The smaller heater consumes only 660 watts, while the larger uses 11,000, or as much energy as is ordinarily supplied to about twenty suburban dwellings. As an advertising device it is nearly a full 100 per cent success. The startled passer-by, after coming very suddenly within its well demarcated heat ray or beam, first hastens to pass through it, but invariably stops to investigate the source of the almost withering warmth. This effulgence of heat is in no way affected by the highest gale, as it is not transmitted by the atmosphere, but by the ether. The heater was made in Cambridge, Mass.

A New Method of Power Transmission

CONSIDERABLE literature has recently appeared concerning a new method of power transmission, invented by Constantinesco. It depends on the propagation of waves of condensation and rarefaction through liquids, water being, of course, the most available.

Some of the mathematical and physical features of the subject are as follows: Five methods of power transmission have been long in use: Steam, direct mechanical power, electric, compressed air and hydraulic. The new method is, therefore, considered as a sixth one and is claimed to have very important advantages. At first it may be thought that wave transmission is

Road sailing in Germany

merely a form of hydraulic action, but there is a wide difference. In hydraulic transmission there is a flow of liquid, but in wave transmission the liquid does not flow. The principle may be illustrated by assuming two cylinders each with a plunger and connected by pipe, the whole apparatus being completely filled with water. If one plunger is moved rapidly up and down it will set up waves of compression at each downward stroke, which will travel through the water at a speed stated to be about 4800 feet per second, and exert a pressure on the other plunger. If the distant plunger is loaded, a reciprocating motion can be established as long as power continues to be applied to the first apparatus. It is claimed that the principle has been brought to practical application, with the advantages of: Simplicity, adaptability, portability, low initial cost and low maintenance charges. A condition of satisfactory operation is that the whole apparatus shall be filled with liquid to the complete exclusion of air, which is secured by special appliances. Wave transmission can produce rotary motion by single phase (one liquid column) or by three phase (three column). The method was first applied to rock drills, riveters, and pile drivers, in which reciprocating motion is employed. By a modification the water can be allowed to flow out, and thus a dustless rock drill has been devised. It is claimed that in a properly constructed line, no appreciable rise of temperature occurs. In some cases oil may be used as the transmitting liquid.

Super-Illumination Wherever You Look

MANY professional and mechanical workers find more or less trouble in getting proper illumination on the exact spot which demands their attention. Fixed spotlights of various sorts may be used, but when the attention is diverted temporarily to other parts of the work it is always necessary to shift the spotlight. Therefore the invention

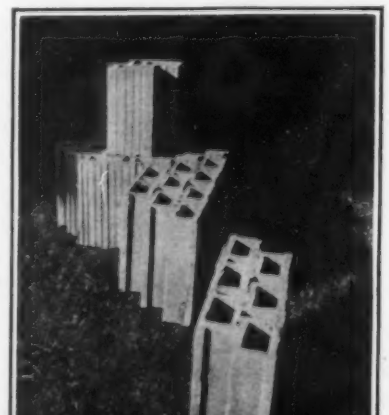
Pair of spotlights worn as spectacles

of Alfred Pimienta of New York, a reflecting light designed to be attached to the head like a pair of spectacles, and which therefore follows his every movement as he works, will be a welcome addition to the equipment of physicians, dentists, automobile mechanics, engravers, watchmakers, machinists, miners, firemen, policemen and others.

The device consists of a pair of parabolic reflectors attached to a pair of spectacle bows. Two electric light bulbs are placed in the focus of the reflectors, so that a powerful beam of light is thrown to a distance of 300 feet. The wearer looks out through a small orifice in the reflectors, but receives none of the direct light of the filament owing to the interposition of a small protective screen. Without thought or conscious effort on the part of the user, the beams of light are always directed on the exact point he wishes to look at.

An Interlocking Building Tile

A TILEMAKER of Victoria, B. C., has put on the market a new building tile of peculiar design, resembling in principle the steel interlocking sheet piling that is generally used for making cofferdams. The units, a single one of which is shown standing on the top of a lower group, are so constructed that the air channels in the wall run vertically, thus favoring the slight but necessary ventilation which must be kept up if condensation and consequent dampness are not to ensue, especially in a cold climate. The tile is also designed in such a way that neither the mortar joints nor any portion of the block itself run directly through the wall. An air channel is met at every point. They are twelve inches in height, by eight inches in thickness, with a width of one foot. It is stated by the makers that this is the first tile that does not require a special tile for the corners of a structure.



A new style of wall tile

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Gas from Garbage

IN *Chemiker Zeitung*, November 23, 1922, pages 1057-9, there is given an interesting account of certain experiments that were made to determine whether or not it was economically feasible to manufacture gas from garbage sweepings, and refuse materials of all sorts. Although these materials contain a considerable proportion of water, as high as 53 per cent, nevertheless it is possible under certain conditions to obtain a gas from them. It was demonstrated that about 25 liters of gas, which had a heating value of 3820 calories per cubic meter, were evolved from one kilogram of the raw materials. The composition of the gas was 51.1 per cent carbon dioxide, 3.4 per cent of heavy hydrocarbons, 8.3 per cent of carbon monoxide, 7.2 per cent of hydrogen, 24.4 per cent of methane and 5.6 per cent of nitrogen. The temperature of the gasification process is much lower than that at which coal is distilled for the production of gas, for in the case of the refuse the evolution of gas commences at a temperature of about 145 degrees Centigrade and at 500 degrees Centigrade the process is almost completed. The important characteristic about this gasification process is that it can and must—for economical reasons—be carried out without the use of any fuel other than that which is derived from the waste materials themselves. Hence the degasified residues recovered from the principal gasification process, mixed with a little tar which is also obtained from the destructive distillation of the waste materials, is used for the production of producer gas, which is then used in heating the retorts in which the main gasification process takes place. The commercial applicability of the process depends on this fact.

Solid Hydrogen

HYDROGEN, which is the lightest substance known, has been frozen into a solid mass by the Bureau of Standards in the course of an investigation. About 100 cubic centimeters of solid hydrogen were obtained and the temperature of the same has been estimated to have been at about 437 degrees below zero on the Fahrenheit scale.

Fucose Made by a New Method

THE Bureau of Standards has developed a new method for the manufacture of the rare sugar, known as fucose. The product is made from seetang, according to Bulletin No. 459.

Fireproofing Wood

VARIOUS chemicals are used for the fireproofing of wood and various methods of impregnation are employed. The following four methods have been most generally used: immersing the wood in cold solutions, immersing in hot solutions, impregnation under pressure in an autoclave, and impregnation under a vacuum in an autoclave and then under pressure. Various tests were carried out at the University of British Columbia to determine which chemicals and which methods were best suited for this purpose. The pressure used was 50 to 60 pounds per square inch. The method last named was found to give a wood with the highest concentration of salts in one impregnation. The pressure method was next best.

The results indicated that wood impregnated with cupric, bismuth, ferric and stannic chlorides, and with alum and barium sulphate ignites below a temperature of 290 degrees Centigrade. These chemicals are properly considered as fire promoters. Ammonium and sodium chlorides, boric acid and sulphate of alumina have little effect. A fire retarding effect above a temperature of 300 degrees Centigrade is produced by zinc, magnesium and calcium chlorides, ammonium sulphate and phosphate, borax, sodium silicate, zinc ammonium phosphate and a mixture of phosphate and borax. It was found that the best salt for this purpose was ammonium phosphate, which evolves an incombustible gas and leaves a covering of orthophosphoric acid on the wood fibers.

Uses for Ethylene Glycol

ETHYLENE glycol is a substance which is much like glycerine and ordinary ethyl alcohol in its properties. It is an odorless, sweet-tasting and nonvolatile liquid, which can be used for various purposes of commercial importance. It is an excellent solvent for waxes, resins, flavors and dyes, resembling ethyl alcohol in this respect, and at the same time it does not possess the intoxicating powers of the latter. It possesses marked preservative properties against bacteria. It can be used as a base for the manufacture of explosives. Other applications for this material may be found in the printing and dyeing of cotton. For further details the reader is referred to the original article in *Chemical and Metallurgical Engineering*, January 24, 1923.

New Uses for Paper

SOME new uses for paper are described in the *Paper and Pulp Industry*, February 15, 1923. It is used for making packings for gas engine and hydraulic work, for box toes, counters and heel boards in the manufacture of shoes, and in candy factories for imprinting trade marks on the bottom of candies. It is also employed for various decorative purposes, including flowers, wall paper and all sorts of fancy novelties. During the war, paper garments were made in Germany. The list includes car wheels, calendar rolls, water pails, electrical insulation of all sorts, bags of every description for endless number of purposes including suitcases and trunks. Spoons, dishes, cups and saucers, table covers, napkins, etc., are made from paper.

Naphthalene for Preserving Wool

IN the South African *Journal of Industries*, January, 1923, there is described the use of naphthalene for preserving wool. An inquiry was made to determine the cause of the stains attributed generally to naphthalene. The results indicated that colored wool often contains as much as half a per cent of iron, and when the wool is treated with aloes, as is done sometimes, the wool stains. Further investigation showed that these stains were not the ones complained of. It was found that if the naphthalene were impure, that is, if it contained traces of phenol, then the wool was stained. Wool in the grease was more subject to this staining than degreased wool. While naphthalene is satisfactory as a wool preservative, care must be taken to see that the naphthalene is perfectly pure, that is, free from phenol, before it is used for this purpose.

Potatoes Cultivated for Starch

POTATOES, that contain large starch granules, will produce not only the highest quantity of starch, but the best quality as well. The content of large granules is also important in such technical operations as drying and distilling, as well as from the standpoints of food value, taste and keeping qualities. An important series of researches is described in the *Zeitschrift fuer Spiritusindustrie* in which various details of the cultivation of potatoes rich in starch and possessing large starch granules are discussed.

Methanol: New Name for Wood Alcohol

THE tendency to call grain alcohol simply alcohol and to apply the same name to wood alcohol has led to serious conditions. The fact there are a large number of alcohols and that each is entirely different from the next one in the series has not been generally appreciated by the public as well as by manufacturers who use alcohols in their manufacturing processes. The result has been that ordinary wood alcohol and grain alcohol have been confused with each other, at any rate as far as their effect on the human organism is concerned. It was generally held that wood alcohol could do no more than intoxicate a person who drank it, just as would ordinary grain alcohol. This is absolutely untrue as wood alcohol is a very bad poison which can cause blindness and death. It has accordingly been decided to divorce the designation, "alcohol," once and for always from wood alcohol and call it by its strictly chemical name, methanol. It is hoped that this will do much to remove the danger of mistaking this alcohol for the edible product, grain alcohol.

New Textile Fiber From Brazil

ACCORDING to the German journal, *Wollen und Leinen Industrie*, Feb. 16, 1923, a new textile fiber has been developed in Brazil. The name of the new fiber is Fibraso. While this fiber has been known to grow in certain localities of Brazil for the past few years no commercial use was proposed for it until recently. The fiber possesses considerable strength and is of fine quality. It dyes well and takes up sizing materials and finishing chemicals easily. There are large quantities of it available in Brazil and it is reported that a company is being formed to put on the market about 100,000 tons yearly.

Disinfectant for Tree Wounds

THE California Department of Agriculture has been experimenting with various materials as disinfectants for wounds made in pear trees, incident to their pruning to counteract the action of pear blight. It appears essential that wounds or cuts in trees, like wounds in animals, must be disinfected. Furthermore, the various chemicals that are used in disinfecting wounds in animals may, with certain limitations, be employed for this purpose. It was found that the most satisfactory disinfectant was a combination of mercuric chloride and mercuric cyanide in water. The proportions used are one ounce of each in four gallons of water. It has also been found that the cyanide compound is best for disinfecting the wounds, while the bichloride of mercury is best for disinfecting the tools.

Anti-Freeze Solutions for Automobile Radiators

GLUCOSE has been used to make anti-freezing solutions for automobile radiators. The Government has been investigating the behavior of such solutions in cold weather. Glucose will prevent a radiator from bursting, but it will lower the freezing temperature of water only to a very slight degree. At low temperature the glucose solution will clog up the radiator.

Making Carbon Black by Electricity

THERE has been a certain amount of legislation passed in certain States against the utilization of natural gas in the making of carbon by the incomplete combustion process due to the fact that by this process valuable byproducts of the gas are lost. The Bureau of Mines has been investigating this matter and has recently published the results of investigation in a bulletin Serial 2417. High voltage discharges were found to decompose the natural gas with the resultant production of carbon black.

The Use of Aluminum Vessels

ACCORDING to the *Zeitschrift f.d. gesamte Kohlensaure-Ind.*, volume 51, number 20, aluminum vessels are particularly well suited for the manufacture of light colored lacquers and varnishes. The color is not affected. On the other hand aluminum is very sensitive to organic acids. When aluminum vessels are used for cooking or distilling, either in the factory or in the household, the interior of the vessels becomes coated with substances which cannot be removed by any ordinary means. The following composition has been found to be very effective in cleaning aluminum vessels. A solution is prepared, containing 90 parts by weight of technically pure crystallized sulphate of alumina and 10 parts of soda crystals. The aluminum vessel is filled with water until the dark colored spots are covered. About one to three teaspoonsful of the above mixture of salts may be added to the water, in accordance to the size of the vessel. The water is brought to boiling and deposit on the aluminum is thereby completely removed.

Sulfur Dioxide From Sulfate

WHEN alkaline earth sulfates, such as sulfate of magnesia, lime and strontium, are mixed with iron and heated, the sulfate is decomposed with the evolution of sulfur dioxide gas. The use of iron in the place of carbon enables this reaction to take place at a lower temperature and with a better yield. Further details regarding the technical process are given in the *Zeitschrift fuer angewandte Chemie*, volume 125, pages 307-348.

The Heavens in June, 1923

The Solar Atmosphere, and How We are Able to Determine Its Density

By Professor Henry Norris Russell, Ph.D.

FOR ALMOST two generations all well informed people have known that the sun was surrounded by a gaseous atmosphere, so hot that even the most refractory metals are vaporized, to mingle their vapors with the other gases. Though all are present simultaneously, and the chemist would have a hard time separating them if the solar material were cooled down so that he could work with it, each vapor acts separately when it comes to absorbing light from the still hotter interior of the sun; and the familiar spectrum lines, once identified by laboratory workers, make our analysis easy.

As has long ago been told in these columns, we can learn from the spectrum much about the temperature of the sun's atmosphere—or of that of a star; for the relative strength of the various lines changes as the gas is heated or cooled. Can we also discover what is the pressure in these atmospheres? This is a harder question but it now appears possible at least to answer it definitely.

We have long known that the pressure in the sun's atmosphere cannot be very great, for in a gas at high pressure the lines of the spectrum become wide and hazy; and the lines of the solar spectrum are sharp. But at ordinary atmospheric pressures, most lines in laboratory sources are at least fairly sharp, so that it remained possible that the pressure in the sun's atmosphere might be as great as that in the earth's, or even somewhat greater.

One line of attack upon the problem is found in certain minute shifts in the positions of spectral lines when the pressure of the gas is increased. Most lines shift toward the red; but a few toward the violet. The older comparisons indicated that the pressure in the sun's atmosphere was several times as great as in the earth's.

But these depended upon the actual amounts of the shifts, and line-shifts may be produced by several other causes—such as the motion of currents in the sun's atmosphere. The resulting complications are very hard to unravel, and a better test is found in the comparison of near-by lines which are shifted by pressure in opposite directions (and which, presumably, are affected in the same direction and almost equally by the other causes of shift). In this way evidence has been obtained at Mount Wilson which indicates that the pressure in the sun's atmosphere is considerably lower than that at the earth's surface.

More delicate tests are available in other ways. For example, there are some lines which, unlike the general run, are conspicuously broad and fuzzy when emitted by an arc at atmospheric pressure, and which can be obtained sharp only by working in a vacuum. Many such lines are known, and they all come fine and sharp in the solar spectrum, indicating a very low pressure.

The Sun and the Laboratory

The same conclusion may be drawn, even more cogently, if we compare the strong lines of the solar spectrum—say the sodium lines in the yellow—with those which are produced in laboratory sources. In the spectrum of an ordinary carbon arc between poles which have been bored out and packed with common salt or any other sodium compound, these lines are very strong and are reversed—the outer and cooler vapor of the arc absorbing some of the light emitted by the inner and hotter portion. The hot vapor at the center is denser, and gives very wide lines, in the middle of which the absorption by the more rarefied outer vapors produces dark centers. These central dark lines, however, if there is much salt in the arc, are much wider than the sodium lines in the spectrum of the sun, which may be observed side by side with the other in the same instrument and at the same time. The inevitable conclusion is that the sodium vapor in the outer part of the arc (forming a layer which can at most be but a small fraction of an inch in thickness) absorbs much more powerfully than all the sodium in the sun's atmosphere, though the latter is several hundred miles thick. Now the pressure of the vapor in the laboratory arc must be less than that of the atmosphere, for other gases are mixed with it to make up the total. There are other gases in the sun's atmosphere, too; but making all allowances, it seems reasonable to conclude that a layer of the solar atmosphere, at our standard pressure of fifteen pounds to the square inch, and only a few feet or yards thick, should give wider lines than are actually observed. This would indicate a very low pressure indeed; but the relation between the width of a dark line, and the density and depth of the atmosphere which absorbs it, is not well enough worked out to enable us to put our results into definite numbers.

Other Lines of Attack

Certain other tests are more promising in this respect. The sun's atmosphere must be full of free electrons—knocked out of those atoms which lose them easily. In such a gas, the electric forces exerted by these electrons on near-by atoms would tend to split up and widen out the lines; and the effect is roughly calculable. It is found that the lines—especially those most sensitive to electrical action—will be fine only if the pressure is less than a thousandth part of our ordinary standard. Other lines of argument—some dealing with the widening of the lines by other influences, and some with the effect of pressure upon the ionization of atoms in the solar atmosphere—all lead to much the same result, and indicate that the pressure in the region where the lines of the solar spectrum are absorbed can hardly exceed 1/1000 of that at the earth's surface, and is probably ten times less.

But at so low a pressure, the density of this region must be exceedingly small—especially when we consider how high the temperature is. There is probably less than a hundred-thousandth as much gas per cubic inch there as here. Such a rarefied gas we should have called a pretty good vacuum until the modern requirements for X-ray tubes and the like raised our standards in that respect.

In the enormous depth which surrounds the sun, even so thin an atmosphere may—and doubtless does—produce the observed effects. But why do we not get light from deeper levels—say, where the pressure is one per cent of what prevails on earth? and why do we not therefore find all our solar lines accompanied by broad diffuse shadings, or wings?

Here the electron theory comes to our aid again. Electrons are so light that they can be set moving—oscillating—by the electric forces in the light-waves themselves. If this is all that happens, nothing follows beyond a very slight scattering of the light; but if the atoms are thickly enough strewn in the gas so that the electrons bump into them often, much of the energy of their motion is transferred into motion of the atoms, and heats the gas at the expense of drawing more energy from the light-waves. Calculation on this basis shows that, even at a pressure of a hundredth of an atmosphere in the ordinary use of this word, the solar gases should be opaque in a thickness of a few miles; so that we cannot see far down into the sun. Only the outer, highly rarefied part of the sun's atmosphere is accessible to our vision; and so when we look at the orb of day, we gaze through a near-vacuum into an incandescent fog.

At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

At 9½ o'clock: June 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

The Heavens

On a clear June evening the finest part of the sky is in the south, where we see Scorpio and Sagittarius, below the splendid star-cloud which, as we have come to realize, marks the deeper and denser portions of the Milky Way. Above these is the tangled mass of Ophiuchus and Serpens, and higher, in the zenith, are Hercules and Corona. To the east are Lyra, Cygnus and Aquila—another very fine region. Lower down, in the northeast, we find Cepheus and Cassiopeia. Draco and Ursa Minor are high in the north, with Ursa Major in the northwest, Leo low in the west, and Boötes high. Virgo is the only prominent constellation in the southwest; but Jupiter and Saturn brighten up this region very considerably at the present moment.

The Planets

Mercury is a morning star all the month, and should be easily seen during the last half of it. He is in elongation on the 22nd, 22 degrees from the sun, and rises before 3:30 A. M.

Venus is also a morning star, and close by. The two planets are in conjunction on the 21st, though not very closely, Mercury being nearly three degrees south of Venus. On the 23rd, both are near Aldebaran, Mercury being about two degrees north of the star, and Venus 2½ degrees north of her sister planet. Mercury is brighter than Aldebaran, but will probably not look so, being overshadowed by Venus, which is forty times brighter.

The spectacle will be a pretty one for the early risers. Mars is an evening star, and sets only about an hour later than the sun; hence he can hardly be seen.

Jupiter is on the borders of Virgo and Libra, and comes to the meridian at 9 P. M. in the middle of the month. Saturn is in Virgo, and souths at 7:20 P. M. on the same date.

Uranus is in quadrature west of the sun on the 8th, and is observable in the early morning. Neptune is an evening star in Cancer, setting about 11 P. M.

The moon is in her last quarter at 4 A. M. on the 6th, new at 7 A. M. on the 14th, in her first quarter at 4 P. M. on the 21st, and full at 8 A. M. on the 28th. She is nearest the earth on the 25th, and furthest away on the 9th. During the month she passes near Uranus on the 6th, Venus and Mercury on the 12th, Mars on the 15th, Neptune on the 18th, Saturn on the 22nd, and Jupiter on the 24th.

At 6 P. M. on the 22nd, the sun reaches its greatest northern declination, and enters the "sign" of Cancer—at which time, by the familiar almanac reckoning, summer commences.

Princeton University Observatory,
April 7, 1923.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGE, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles

By mounting his concrete mixer on a motor truck, this contractor gains time

Concrete Mixer Moved Economically

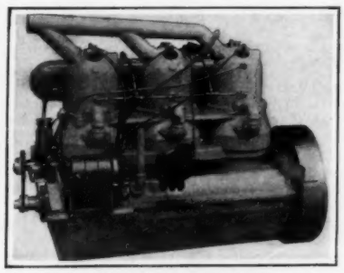
WHEN Mr. Stanley Carman, masonry contractor of Woodmere, Long Island, had a little difficulty in the transportation of his concrete mixer, he hit upon the idea of mounting it on his four-wheel drive truck. He also mounted 10-inch steel flanges on the front wheels of his truck and 12-inch flanges on the rear wheels. These, he claims, enable his truck to go over soft ground which is frequently encountered in going onto many jobs. When Mr. Carman is ready to move his mixer from one masonry job to the next, he merely cranks the truck and away he goes. The motor truck cuts down the moving time between jobs considerably and facilitates the placing of equipment in just the location where it can be used to the best advantage on the job. One marked advantage of trucks having the power transmitted to all four wheels is the superior tractive ability which makes them well suited for contracting and construction work of all kinds. This is especially true at the starting of operations, when ground is rough or soft and also in excavating work, before an opportunity has been afforded to lay even a temporary roadbed.

New Automobile Motor

A NEW motor that seems to be well adapted to motor truck service is a combination of three engines—steam and two- and four-stroke cycle gasoline motors. The inventors claim the good points of each are retained, and disadvantages eliminated. As soon as the engine starts to operate, it begins to generate steam by the heat of the exhaust gases that in all former type of gasoline motors are a total waste. The steam that is generated in this manner is used to scavenge the cylinders of dead gases and eliminate carbon at the same time. The steam generator does three things at one time, viz., generates steam, cools the hot gases, and forms a muffler all in one unit.

The motor illustrated herewith is two-cycle in operation, firing the gas in every cylinder at every revolution of the crankshaft. The inventors claim that disadvantages of the former two-cycle engines are entirely eliminated, stating that the engine cannot backfire. There is no mixing of gasoline and oil together as is the case with most two-cycle motors as no base compression is used to transfer the charge. The oil splash lubricates as is the case with all four-cycle engines, but the complicated parts of the four-cycle motors have also disappeared in this motor. As the cut shows, the motor is very simple in design and of strong construction.

There are no valves, sleeves, gears, springs, tappets, cams, cam-shafts or timing gears, and a three-cylinder motor like the one shown, which is equal to the conventional six-cylinder four-cycle power plant in smooth power application and which has more than two hundred parts, has but sixteen complete interior working units. The only working parts are the pistons, connecting rods and crankshaft. Having a compression cylinder in place of crank case compression, this surrounding the firing piston, the loss of gas through bearing is eliminated, and there is effected a material saving of oil over the four-cylinder type, because but half the number of firing



A combination of three engines—steam and two- and four-cycle gasoline engines

cylinders are used to produce the equivalent turning moment of the four-cycle type.

The first working model three-cylinder motor replaced a six-cylinder motor of standard make and is six inches shorter and one hundred pounds lighter, yet the motor shown is all cast iron while the other had an aluminum base and other parts. In upkeep expense the inventors believe the new motor will be in a class by itself, as the only moving parts are the pistons, connecting rods and crank shafts, while the construction expense will be greatly reduced.

Cost of Snow Removal

ACCORDING to the best authorities, snow from 12 to 36 inches, if not too heavy, can be moved by motor trucks, with plow attachments, with excellent results. Trucks should be run on opposite sides of the highway for return trips and should not be operated at more than four miles per hour. A few men should be carried to shovel away the wet snow that piles up in front of the blade. While it is impossible to estimate what snow removal on the highway costs per mile throughout the nation as a general average, on one section, which is typical, under the most severe conditions the cost ranged from $75 to $350 per mile, while in a milder winter the cost was but from $10 to $30 per mile. Certainly this is a very small cost in comparison with the needs of the nation for adequate highway transportation all the year, apart from the usefulness of snow clearing in helping to maintain improved roads.

It is expected that proper organization will make it possible to keep all main or trunk-line highways open for traffic all the year round. The only thing to do is to divide the road into districts and have adequate snow-removal equipment assigned to each district. As the cut shows, plows can be attached to trucks of standard make and when there is no snow, the plows can be easily removed and trucks used for any other purpose. In sections where the snowfall is heavy, track-laying tractors can be employed to supplement the truck-propelled plows.

Gasoline Lift Truck for Factory Use

SOMETIME ago a well-known manufacturer of gasoline engine propelled industrial vehicles announced the production of a small tractor for use in inter-department transportation in factories, this being designed so it could pull loaded trailers between buildings and into the shops. A new lift truck is now in production that offers a number of advantages for shop use not possessed by the tractor-truck type. The Truklift conforms in appearance and uses to the electric elevating lift trucks which have been used in industrial plants for many years, but low initial cost, ease of maintenance, flexibility and continuous twenty-four-hour service are distinguishing characteristics claimed for it by the builders.

The loading platform is 26 inches wide by 54 inches long and will elevate its load of 4000 pounds from a minimum of 11 inches to a maximum of 16 inches from the floor in eight seconds; automatic stops provide for both up and down limits; elevation can be stopped by hand-control lever at any point. The total weight, ready to go to work, is

Typical snow plow used in connection with a standard motor truck

2500 pounds; over-all length of machine is 107 inches; width 35½ inches and height 51 inches. The driving and elevating controls are mounted on the rear of the engine compartment and are operated by the driver, who drives standing. The brake lever pedal is under the operator's foot and so arranged that the machine stops automatically if for any reason the operator steps off while the machine is running.

The lifting mechanism is operated by hydraulic pressure. Power for locomotion and elevating the load is derived from a 15-horsepower, 4-cylinder tractor engine with a 3⅛-inch bore and 4½-inch stroke. The engine is mounted at the rear in a closed compartment, containing transmission, governor, vacuum tank, radiator and other parts. A three-point suspension is used, the steering wheel forks being supported in a steel casting which is pivoted at the center of the frame on a chrome nickel steel pin two inches in diameter. The drive is through a bevel gear axle equipped with ball and roller bearings located under the loading platform. Driving wheels are cast steel with pressed-on rubber tires 10½ inches by 5 inches; steering wheels are cast steel disc type with pressed-on rubber tires 16 inches by 3½ inches.

S. A. E. Discusses Methods of Gasoline Conservation

THE research department of the Society of Automotive Engineers has forwarded to Washington a statement for the consideration of the La Follette Senate Committee which is investigating the gasoline situation. The society declares that fuel conservation can be had by improved carburetion, improvement in gasoline, better engines and education of the user. The factors which promote fuel economy are summarized as follows:

"(1) Universal adoption of means for maintaining the engine and the carbureter and intake system at the best operating temperature.

"(2) The adoption as rapidly as possible of carbureting devices which can be adjusted once and for all by the maker to supply automatically a correct amount of fuel as completely atomized as possible for economical operations under all conditions.

"(3) An economically correct grade of gasoline supplied uniformly throughout the country but suitably varied, if possible, to meet climatic conditions.

"(4) Education of the user of motor vehicles to the advantages which will accrue to him through fuel economy.

"(5) The gradual adoption of engines using higher compression ratios with resulting higher fuel economy.

"(6) Servicing of automotive equipment to maintain it in satisfactory condition for economy of operation. This refers to the entire vehicle as well as the engine, and present conditions can be improved by education of the public and of the garage mechanic, and by improvements in the service facilities offered by the dealers.

"All these factors, except, perhaps, the education of the general public, are receiving a continually increasing amount of study by the Society of Automotive Engineers and the manufacturers, and we believe that much has already been accomplished in eliminating fuel waste. The necessity of meeting popular demands inconsistent with economy, and the difficulty of putting new developments into immediate production have retarded this accomplishment."

Small gasoline lift truck employed for inter-department transportation in modern factories

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

FLYING MACHINE.—W. L. BUSWELL, Amarillo, Texas. This patentee has in view a flying machine having various features designed to make it readily responsive to the operator. The machine includes provision to bodily move the wings and duplicate as nearly as possible the action of a bird, to provide for varying the angle of the wings, so that the inertia of the machine may be overcome and sufficient momentum acquired prior to inclination of the wings to permit of a ready "Take off," as well as to move the wings out of the horizontal plane so as to effect a natural "banking" without strains. The entire rear portion or tail is made capable of moving in the manner of a bird in flight. (See Fig. 1.)

Pertaining to Apparel

SHOE CONSTRUCTION.—P. F. MCNULTY, 259 Fifth Ave., New York, N. Y. The invention contemplates the provision of shoe scientifically constructed to effect the proper and natural growth of the foot of the wearer, the sole being constructed in such a manner as to properly support the arch of the foot, and to distribute the weight of wearer at the proper points of contact, and to provide means for separating the great toe from the next adjacent toe in order to prevent malforming of the other toes.

COLLAR.—J. J. EAGAN, New Castle, Pa. The object of the invention is to provide a collar of the so-called turn-down type with a novel form of buttonhole on the under tab, adapted to facilitate the buttoning of the collar about a person's neck and properly adjusting the same after being buttoned. A further object is that the buttonhole be adapted to permit locking the associated collar button in adjusted position. (See Fig. 2.)

GARMENT SUPPORT.—T. L. CAUDLE, Wadesboro, N. C. The foremost object of the invention is to provide a device for supporting trousers from the shirt of the wearer, by which the use of suspenders may be dispensed with and a belt worn for appearance only. A further object is to provide a support comprising a pliable base suitably mounted on the inside of the trousers, with a resilient supporting member stretched between its extremities, the base preventing excessive contraction, thereby avoiding the puckering of the trousers.

HEAD PROTECTOR.—H. E. TURPIN, c/o St. Mary's College, Oakland, Calif. The general object of this invention is to provide a resilient protecting device concealed within a hat to protect the head of a wearer from sudden blows. A further object is to provide a device which will be light in weight, automatic in operation, durable in use, and will not interfere with the appearance of the hat.

Electrical Devices

WINDING REEL.—S. B. BENNETT and D. MCCORMICK, Bend, Ore. This invention relates principally to reels for electric wire, but can be used for the winding of air or water hose, the principal object is to provide a reel which may be used for winding the intermediate portion of a line to shorten the length of the line without disturbing fluid flow, or the passage of an electrical current through the line which is wound. The device is particularly adapted for use in connection with a telephone or other flexible line.

MAGNETIC INTERLOCKING REPEATER.—C. J. ROGERS, Great Western Electric Co., Morris, Okla. This invention relates to telegraph relays or repeaters. One of the principal objects is to provide a repeater wherein the continuity of the transmitting circuit connections is preserved after the termination of an electrical impulse in the transmitting circuit, by means of mechanical action, and not by means of a holding coil or other equivalent electrical means.

REFLECTOR.—I. LITNER, 494 Gates Ave., Brooklyn, N. Y. The invention relates to a reflector capable of receiving a globe as well as an ordinary electric lamp. An object is to provide a reflector having more than one reflecting surface, one surface intended to reflect the light emitted by the bulb and the other to reflect the light emitted by the globe which receives the reflected light of the bulb. (See Fig. 3.)

WINDING DEVICE FOR DROPLIGHTS.—C. V. JOHNSON, 1595 Haight St., San Francisco, Cal. Among the objects of the invention is to provide a simple supporting and winding means for droplights, and to make the complete device readily portable and adapted to be hung up in a particular location when needed, and to provide a guide for the conductor cord to guard the cord in all directions in its movements into and from the casing of the winding mechanism.

Of Interest to Farmers

QUEEN-EXCLUDING HONEY BOARD.—D. G. LITTLE, Hartley, Iowa. Among the objects of this invention is to provide a honey board arranged to be placed between the super and the brood chamber of a beehive, to prevent the queen from entering the super chamber and depositing eggs among the combs, when it is desired to obtain pure honey. An important object is to provide special means for constructing and fastening the board.

VACUUM ASPIRATOR.—E. T. DRAKE, c/o G. E. Reed, 1-4 Batts Bldg., Fostoria, Ohio. The invention relates to aspirators for grain. The object is to provide a vacuum aspirator which is especially adapted for use in the handling and manufacturing and for aspirating and purifying grain, such as wheat, corn, rye, oats, barley and grain by-products, and which is of simple and durable construction and inexpensive to manufacture.

FARM TRACTOR.—O. L. LEWIS, 7358 Rhodes Ave., Chicago, Ill. The invention relates generally to farm tractors of the front wheel driving type. The primary object is to provide a tractor capable of pulling agricultural implements, vehicles and the like, and adjustable to provide the required overhead clearance for orchard cultivation, permitting its ready passage beneath branches of trees, and permitting the final cultivation of high growing crops such as corn, cane, cotton and the like.

PLOW ATTACHMENT FOR TRACTORS.—B. W. MORTON, Williston, Fla. The object of the invention is to provide means whereby a plow of the landside type may be directly attached to a tractor and disposed so that it may be observed by the driver of the tractor during operation. A further object is to provide means for eliminating the possibility of breakage in case the plow should meet with a well anchored obstruction.

GATE AND OPERATING MEANS THEREFOR.—A. G. MAASDAM, 2017 Manderson St., Omaha, Neb. This invention refers to operating mechanism for gates, and is especially adapted for farms and rural districts to control an entrance on a roadway where it is inexpedient to plant a post, the gate being mounted to swing from one side of the line of fencing and adapted to be actuated at a convenient distance so as to be opened when approaching and closed after passing without dismounting from a vehicle.

HEN'S NEST.—C. A. PARFREY, Richland Center, Wis. An object of this invention is to provide a device which is collapsible so that it may be readily opened up for the purpose of cleaning and disinfecting. A further object is to provide a nest formed almost entirely of wood, which will occupy a comparatively small amount of space when being shipped, and which is so simply constructed that it may be readily assembled and disassembled.

Of General Interest

MOLD—G. H. GERAERDTS, 1445 Boone Ave., Bronx, N. Y. The invention particularly relates to a mold for producing window sills of cement or other plastic materials, the sills being provided on the upper face with an inclined depression constituting a drain and on the under face adjacent the edge with a groove for preventing water from passing over the window sill and from flowing onto the wall of the building. The invention aims to provide an adjustable mold for producing sills of various sizes.

REEL—A. E. JENKS, Thackery, Ohio. Among the objects of the invention is to provide a reel for fishing rods having means whereby the same may be collapsed when not in use, and means whereby the wear on the arms or spokes may be taken up as occasion requires, and whereby the line supported thereby may be readily dried. The reel is of simple construction and may be inexpensively manufactured.

PROCESS FOR PLATING METAL ON NON-METALLIC SURFACES—E. F. DIETRICH, 1315 Leland Ave., Chicago, Ill. This invention relates to a process for plating metal on non-metallic surfaces, such as china, porcelain, glass, or the like. An object is to provide a process in which metals, such as silver, gold, or nickel, may be permanently deposited by an electro-plating bath an impervious glue being employed for supporting the current conducting substance, the process is such that the metal deposit will not become loosened by heat or moisture.

SCALP APPLIANCE—E. A. FARRON, 5040 Grand Blvd., Chicago, Ill. An object of the invention is to provide a device for stimulating the growth of the hair by providing a partial vacuum adjacent the scalp for releasing dandruff and removing the loose dandruff to a suitable compartment, and for removing short, broken, or loose hairs from the scalp, which are not easily removed by brush or comb. A further object is to provide a device which may be kept in a sanitary condition.

LADDER.—J. H. DWIGHT, 479 Stewart Ave., Atlanta, Ga. The invention relates more particularly to the rungs of ladders. An important object is to provide a ladder rung which may be readily and conveniently applied to the sides of a ladder in such manner that the loosening or loss of the rung is absolutely prevented, the rung is adjustable and the spaces may be varied as desired.

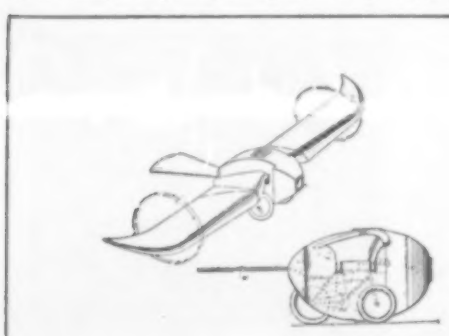
BOOKSTAND.—F. M. PRIEST, Rusk, Texas. An object of the invention is to provide a bookstand which will be particularly useful in county clerks' offices and other places where it is necessary to copy from or make entries in large heavy books or manuscripts. A further object is to provide a stand of this character, in which the book supporting member is adjustable both vertically and angularly, and a stand which will be strong and durable in use, and comparatively inexpensive to manufacture.

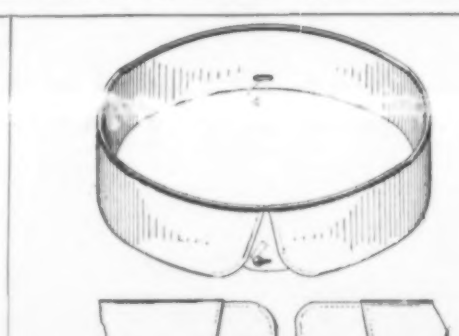
POT PROTECTOR.—J. V. JEWELL, 935 Dawson St., Waterloo, Iowa. Among the objects is to provide a protector which will support a coffee pot over a gas burner in such a way that there is no danger of blackening the sides of the pot, or the handle becoming scorched or overheated while the pot is on the fire. A further object is to provide a device which is simple, strong, and may be conveniently shifted from one burner to another while it is hot.

MILL BASKET.—H. L. SMITH, Smith Mfg. Co., Dalton, Ga. The general object of the invention is to provide a basket for use in mills, employing canvas and a stiffening frame in the structure, and having means for giving the basket a knock-down form, and so arranged that the stiffening rim is detachably secured to uprights which themselves are removably secured to a base.

WINDOW.—S. U. BARR, c/o W. H. Jackson Co., 335 Carroll St., Brooklyn, N. Y. An object of the invention is to provide a window arranged to permit of easily and conveniently moving the sashes into open or closed position and to render the window completely dust and air and watertight when the sashes are closed. A further object is to prevent rattling of the lower sash in whatever position it may be, and to prevent its being raised from the outside.

HAT TRAY.—J. S. BOOTH, 816 So. Haskell Ave., Dallas, Texas. The invention particularly relates to a tray adapted for use with straw hats. The object is to provide a tray which will safely pack or crate a relatively large number of hats in a compara-





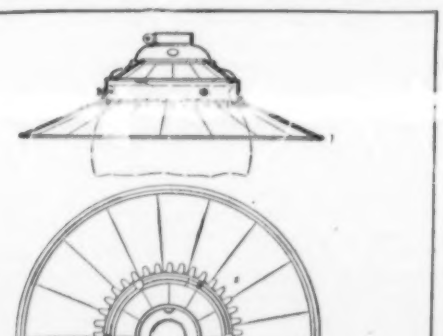


Fig. 3. To heighten the reflecting efficiency of the

tively small space and in trunks as is the practice among traveling salesmen. The device is adjustable and capable of use with various styles and sizes of hats, it is also of simple and durable construction.

DRAW LATCH.—O. M. STEVENS, Burke, Idaho. The general purpose of the invention is to provide a latch for a draw that will exclude children without the necessity of locking the draw and yet will enable the draw to be unlatched and opened by adults with facility and dispatch, the unlatching device being associated with a turntable handle-bar supported in brackets.

CLASP.—D. H. NEILLY, 22 Chamber St., Bradford, Pa. The object of the invention is to provide a clasp especially adapted for use with rifle straps or the like, which is of simple and durable construction and which automatically exerts a powerful gripping action upon sections of the rifle strap to maintain it in desired position, the device is easily adjusted and is quickly and uniformly effective in any position.

ENVELOPE.—C. O. STEMEN, 54 Watson St., Detroit, Mich. The invention relates more particularly to an envelope of that type adapted for use where a reply is anticipated or for commercial use where an envelope is placed inside another envelope, the device serving to obviate the necessity of employing two different sizes of envelopes, thus resulting in a great saving of paper. The envelope is folded in such a way as to constitute a sending and return closure, with the return address printed to avoid mistakes.

SECTIONAL BOAT. — A. E. OLSON, Holton, Mich. An object of the invention is to provide a boat made up of a plurality of detachably secured sections adapted to be disassembled and packed into small compass for storage or transportation, and assembled at will without the use of any tools, to form a boat of ordinary construction. A further object is to provide a knock-down boat, the sections of which are arranged in nested relation whereby they may be supported upon the running board of an automobile.

DISPLAY STAND.—W. J. DODD, 442 W. Main St., Lexington, Ky. Among the objects is to provide a display stand affording facilities for releasably holding a plurality of boxes or containers in position to display the contents of such boxes or containers to best advantage. The device is of simple construction, and will take up but little space in a store.

BUNDLE PROTECTOR.—E. L. BRUCE, JR., 319 Ridgeway, Little Rock, Ark. This invention has for an object to provide a device which can be readily applied to bundles of strips or the like, to protect the same during the handling incidental to shipment. A further object is to provide a device that can be produced cheaply and therefore be discarded with but slight loss when out of service.

PEANUT BUTTER AND PROCESS FOR MANUFACTURING THE SAME.—J. L. ROSENFIELD, 1916 Webster St., Alameda, Calif. This process comprises pressing the major portion of the oil from the peanuts and removing the same therefrom, comminuting the resultant cake or mass, hydrogenating the oil thus removed, reincorporating the hydrogenated oil with the comminuted mass and adding salt thereto while mixing the same. The process does not require the use of machinery other than that usually employed.

FOLDING TABLE.—E. E. MCGREW, 2124 Y St., Lincoln, Neb. An important object of the invention is to provide a folding table which is constructed entirely from metal so that the same will not warp or crack as the result of being subjected to dampness or to the strains incident to transporting the same in its folded position. A further object is to produce a table which may be quickly set up, provided with no detachable parts and which will occupy a small space when folded.

WEATHER STRIPPING FOR DOORS.—F. J. KENNARD, Box 831, Beggs, Okla. Among the objects of this invention is to provide means whereby a threshold may be carried by the door with which the same is associated and automatically raised and lowered with the opening and closing of the door respectively, the device is so constructed that it is not likely to get out of order.

AUTOMATIC STOPPING ATTACHMENT FOR PHONOGRAPHS.—B. W. GARDNER, Box 1474, Indianapolis, Ind. The invention has for an object the construction of elements which, used in conjunction with

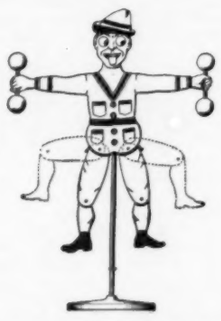


Fig. 4. This toy and animated advertising device is the product of Maggie B. Conway, patentee

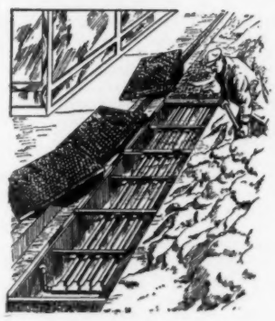


Fig. 5. Removal of snow by melting on heating pipes, is the invention of W. F. Guerin

effect an automatic stopping of the machine when the stylus, carried by the tone arm, reaches the end of a record groove. A further object is to produce a simple device which requires no attention once the mechanism is put into action.

WINDOW SCAFFOLD. — M. DWORK, 2236 78th St., Brooklyn, N. Y. An object of the invention is to provide a safe and reliable support for persons employed in the dangerous task of cleaning the outside of windows. A further object is the provision of a support which furnishes not only a comfortable seat but sufficient room for conveniently holding articles for use in the work and a safeguard against accidental precipitation from the support.

SLED.—L. H. M. LUHRS and A. H. PASSBACK, 2641 Jerome Ave., Bronx, New York. This sled comprises a curved bottom board and an adjustable seat frame which may be adjusted to accommodate the individual using the sled, a handle attached to the seat frame serving as a balancing means, and an adjustable foot rest on the bottom board to serve as a bracing means for the user.

EXPOSURE METER.—F. MELLA, Casilla 3244, Santiago, Chile, S. A. The invention aims to provide a meter adapted for use in taking photographs. The object is to construct a device by means of which an amateur may set various elements to correspond to known conditions, whereby to obtain a final reading which may be implicitly relied upon to produce a perfect result in photography.

BOTTLE CLOSURE. — H. IPSEN, 69 Liberty St., Brooklyn, N. Y. An object of the invention is to provide a bottle cap so constructed that it may be easily applied or removed without the use of tools. Another object is to provide a cap of the crumped type wherein one part of the cap acts as sealing means and the other as locking means, the whole being applied or removed by hand.

PACKING CASE. — H. H. READ, 84 Cranley Gardens, Muswell Hill, London N. 10, England. The invention relates to packing cases of the kind which are bound with strips of iron [illegible] and has for its object to provide means for preventing pilfering during transit of goods in the case. According to the invention hoop iron binding strips are secured around the case in the grooves, by means of rivets, wire or the like, the outer ends being sealed by soldering or the like.

PEN.—R. J. ESTES, Coalgate, Okla. The general object of the invention is to provide a writing pen employing a stylus having a tapered front end, and an element with which the stylus has threaded engagement for longitudinal adjustment by the turning of the stem of the pen, and a feed control means at the front end through which the stylus may be projected.

CONTAINER CLOSURE AND POURING SPOUT.—P. A. BALISON and I. G. STATEROPOULOS, 596 Palisade Ave., Grantwood, N. J. The invention relates to sanitary dispensing closures for milk bottles and similar vessels, an object being to provide a device which not only prevents the entrance of extraneous matter into the milk but which will facilitate the pouring. A further object is to provide a device which may be quickly and firmly applied and very readily sterilized.

RECEPTACLE.—J. RAGGIO and F. BONVILLE, Mass. This invention relates to an instrument for facilitating the measuring of the velocity of cloud travel and designating the direction of such travel, it comprises a plane mirror for reflecting a cloud image, a rod for establishing a line of sight between the mirror center and a point on the cloud, and a quadrant along which the sighting rod is adjustable, having the natural tangents of the angles formed by the sighting rod and mirror graduated and marked thereon.

ANIMATED FIGURE.—MAGGIE B. CONWAY, 833 Main St., Danville, Va. This invention relates to animated figures and has for its object to provide a figure adapted to partake of original and unusual movements and actions to attract attention and amuse observers, whereby it may be used either as an advertising device or a toy. The device is simple, durable in construction and easy and inexpensive to manufacture. (See Fig. 4.)

VENTILATOR.—A. FAJALIC, c/o Mich. Metal Enrichment Co., 11739 Kercheval Cor. and Hart Ave., Detroit, Mich. An important object of this invention is to provide means for rotatably supporting the body of a ventilator so that the same may freely rotate as the result of the passage of air through the same. A further object of the invention is to provide a ventilator which is quiet, efficient in operation and inexpensive to manufacture.

VANITY CASE.—W. G. KENDALL, 118 Market St., Newark, N. J. An object of the invention is to provide a vanity case which will securely retain a carrier, for rouge or other cosmetics, in place on the bottom of the case, and to provide a form of carrier sides in the provision of a receptacle for drinking water which includes a separate compartment for ice as a cooling medium, whereby the practice of placing the ice directly in the water is eliminated. The invention further aims to provide means for drawing off the water from the melted ice without emptying the receptacle proper.

BUILDING TILE.—A. H. ROETH, 105 Mount Hope Place, Bronx, N. Y. Among the objects of the invention is to provide an interlocking tile provided with both vertical and horizontal air spaces which will prevent moisture from seeping through the wall, the air spaces being provided between every mortar joint so that if the outside joint absorbs moisture there is no danger of it seeping through.

STORE CABINET.—W. P. WALKER, c/o Wilson Drug Store, Spartanburg, S. C. Among the objects of the invention is to provide more particularly a floor cabinet for stores, which will combine storage and display fixtures in such manner as to preclude ready disturbance of the display arrangement after they are once made, and will at the same time admit of convenient access when the arrangement of the goods are desired to be altered from time to time.

SWIMMING SHOE.—V. DAHLER, c/o Noack, 977 Grant Ave., Bronx, New York. The invention relates to a simple accessory for swimmers. An object is to provide a swimming shoe which includes hingedly connected blades which function to increase the propelling area of the foot during the rearward movement, and which are foldable during the forward movement of the leg and foot to decrease the area of resistance.

NEPHOSCOPE.—A. MCADIE, Harvard University, Blue Hill Observatory, Readobject is to provide a case which will be neat and attractive, and inexpensive to manufacture.

GOPHER POISONER.—W. J. MERVYN, Box 80, Cliff-Hamilton, Saskatchewan, Canada. The invention particularly relates to poison distributers. An important object is to provide means whereby a predetermined quantity of poisoned grain or the like may be discharged from the distributer at will. A further object is to provide a distributer which is simple, efficient and cheap to manufacture.

SNOW REMOVING SYSTEM.—W. F. GUERIN, 1914 69th St., Brooklyn, N. Y. This invention contemplates a snow removal system which includes trenches located adjacent the gutter of a street in which heating pipes are arranged for maintaining a predetermined supply of water at a sufficient temperature to immediately melt the snow introduced to the trenches. A further object is to provide the trenches with normally closed removable covers, and with overflow and cleanout conduits communicating with the sewerage system of the city. (See Fig. 5.)

CIGARETTE CASE.—G. H. SPENCER, c/o Collison & Co., Glen Osmond, South Australia, Australia. This cigarette case comprises a thin flat metal case having in one side a removable cover and within the other side an ejecting device, said cover carrying a compression plate attached by means of a spring, and the ejecting device for removing the cigarettes one by one, comprises a spring-operated slidable rod carrying upon one end a shutter and upon the other end an ejecting plate.

AUTOMATIC STOP FOR PHONOGRAPHS.—A. ROGATI and L. ARONNE, Kimberley Phono Co., 226 Fayette St., Perth Amboy, N. J. Among the objects of the invention is to provide a brake for cooperation with the turntable of a phonograph, said brake having devices associated therewith to initiate the gripping action thereof automatically according to the position to which the tone arm of the machine has approached in the normal running operation of the machine.

HOLDER.—H. BERLOW, c/o Maxwell Brushes, Inc., 496 East 134th St., New York, N. Y. The invention aims to provide a holder primarily intended as a support for bathroom appliances, such as an ordinary tube used in connection with a spraying attachment for a faucet, and by means of which said attachment will be supported in such manner as to preclude of its being accidentally detached from the holder, or injury occurring to the tube during its suspension.

MAILING DEVICE.—J. T. MCKENZIE, JR., 117 Hillcrest Road, Ridgewood, N. [illegible] The object of the invention is to [illegible] envelope, containing a letter of [illegible] sent out at the same time [illegible] or the like, to hold them [illegible] by the mail, thus assuring [illegible] two at the same time. [illegible] the provision of a [illegible] opened by the postal [illegible] the catalog.

BURIAL VAULT [illegible] 146, East Orange, [illegible] invention is to provide [illegible] which is adapted to [illegible] burial vault after the [illegible] the vault, and to drain [illegible] may collect in the vault from [illegible] the casket, whereby the casket [illegible] tected from any moisture within.

DISPENSING DEVICE.—L. [illegible] FANY, Winsted, Conn. The invention [illegible] to provide a dispensing device particularly [illegible] intended for use in connection with pins, [illegible] paper clips, but not necessarily limited to [illegible] this adaptation, and by means of which pins [illegible] readily, in extremely neat appearing order [illegible] will be produced which will present the elements to be dispensed in such a manner that the same are readily accessible.

EXPLOSIVE CONTAINER.—W. BECK, address G. C. Shillers, Atty., Tulsa, Okla. This invention relates to explosive containers for use in oil and gas wells. An object is to provide a container consisting of inner and outer shells, the outer shell forming a means for protecting the inner shell from frictional contact with the wall of the casing, and also to prevent the inner shell from being punctured, and prevents any explosive which might escape from the inner shell, from causing a premature explosion.

ROLLER.—R. D. SCOTT and J. G. CADWELL, Box 944, Raslan, Wash.

spectrum lines, once identified by laboratory workers, make our analysis easy.

As has long ago been told in these columns, we can learn from the spectrum much about the temperature of the sun's atmosphere—or of that of a star; for the relative strength of the various lines changes as the gas is heated or cooled. Can we also discover what is the pressure in these atmospheres? This is a harder question but it now appears possible at least to answer it definitely.

We have long known that the pressure in the sun's atmosphere cannot be very great, for in a gas at high pressure the lines of the spectrum become wide and hazy; and the lines of the solar spectrum are sharp. But at ordinary atmospheric pressures, most lines in laboratory sources are at least fairly sharp, so that it remained possible that the pressure in the sun's atmosphere might be as great as that in the earth's, or even somewhat greater.

One line of attack upon the problem is found in certain minute shifts in the positions of spectral lines when the pressure of the gas is increased. Most lines shift toward the red; but a few toward the violet. The older comparisons indicated that the pressure in the sun's atmosphere was several times as great as in the earth's.

But these depended upon the actual amounts of the shifts, and line-shifts may be produced by several other causes—such as the motion of currents in the sun's atmosphere. The resulting complications are very hard to unravel, and a better test is found in the comparison of near-by lines which are shifted by pressure in opposite directions (and which, presumably, are affected in the same direction and almost equally by the other causes of shift). In this way evidence has been obtained at Mount Wilson which indicates that the pressure in the sun's atmosphere is considerably lower than that at the earth's surface.

More delicate tests are available in other ways. For example, there are some lines which, unlike the general run, are conspicuously broad and fuzzy when emitted by an arc at atmospheric pressure, and which can be obtained sharp only by working in a vacuum. Many such lines are known, and they all come fine and sharp in the solar spectrum, indicating a very low pressure.

The Sun and the Laboratory

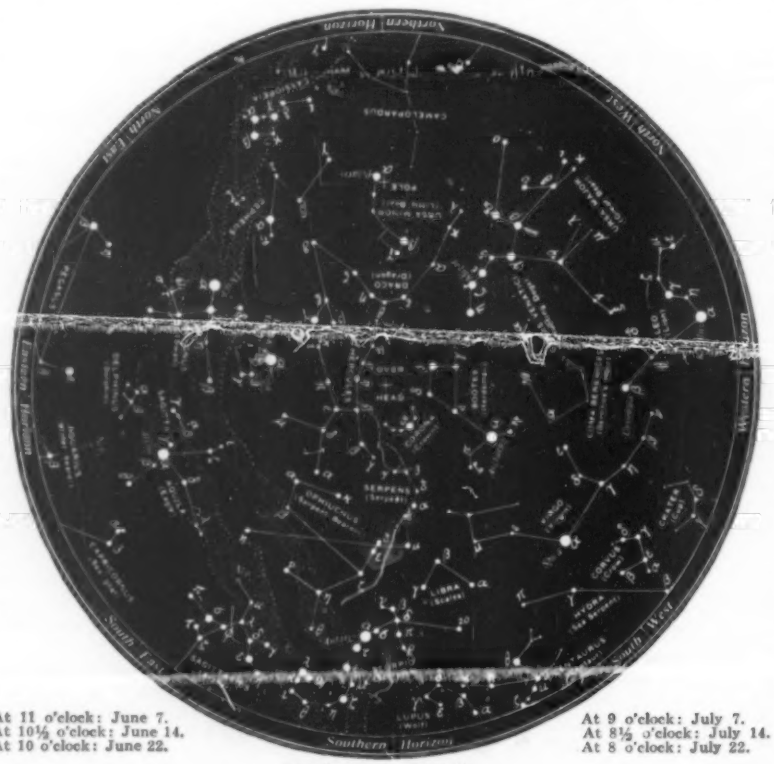
The same conclusion may be drawn, even more cogently, if we compare the strong lines of the solar spectrum—say the sodium lines in the yellow—with those which are produced in laboratory sources. In the spectrum of an ordinary carbon arc between poles which have been bored out and packed with common salt or any other sodium compound, these lines are very strong and are reversed—the outer and cooler vapor of the arc absorbing some of the light emitted by the inner and hotter portion. The hot vapor at the center is denser, and gives very wide lines, in the middle of which the absorption by the more rarefied outer vapors produces dark centers. These central dark lines, however, if there is much salt in the arc, are much wider than the sodium lines in the spectrum of the sun, which may be observed side by side with the other in the same instrument and at the same time. The inevitable conclusion is that the sodium vapor in the outer part of the arc (forming a layer which can at most be knocked out of those atoms which lose them easily. In such a gas, the electric forces exerted by these electrons on near-by atoms would tend to split up and widen out the lines; and the effect is roughly calculable. It is found that the lines—especially those most sensitive to electrical action—will be fine only if the pressure is less than a thousandth part of our ordinary standard. Other lines of argument—some dealing with the widening of the lines by other influences, and some with the effect of pressure upon the ionization of atoms in the solar atmosphere—all lead to much the same result, and indicate that the pressure in the region where the lines of the solar spectrum are absorbed can hardly exceed 1/1000 of that at the earth's surface, and is probably ten times less.

But at so low a pressure, the density of this region must be exceedingly small—especially when we consider how high the temperature is. There is probably less than a hundred-thousandth as much gas per cubic inch there as here. Such a rarefied gas we should have called a pretty good vacuum until the modern requirements for X-ray tubes and the like raised our standards in that respect.

In the enormous depth which surrounds the sun, even so thin an atmosphere may—and doubtless does—produce all the effects we observe. This would indicate a very low pressure indeed; but the relation between the width of a dark line, and the density and depth of the atmosphere which absorbs it, is not well enough worked out to enable us to put our results into definite numbers.

Other Lines of Attack

Certain other tests are more promising in this respect. The sun's atmosphere must be full of free electrons—that the electrons bump into them often, much of the energy of their motion is transferred into motion of the atoms, and heats the gas at the expense of drawing more energy from the light-waves. Calculation on this basis shows that, even at a pressure of a hundredth of an atmosphere in the ordinary use of this word, the solar gases should be opaque in a thickness of a few miles; so that we cannot see far down into the sun. Only the outer, highly rarefied part of the sun's atmosphere is accessible to our vision; and so when we look at the orb of day, we gaze through a near-vacuum into an incandescent fog.



At 11 o'clock: June 7.
At 10½ o'clock: June 14.
At 10 o'clock: June 22.

At 9 o'clock: July 7.
At 8½ o'clock: July 14.
At 8 o'clock: July 22.

At 9½ o'clock: June 30.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on June 7, etc.

NIGHT SKY: JUNE AND JULY

The Heavens

On a clear June evening the finest part of the sky is in the south, where we see Scorpio and Sagittarius, below the splendid star-cloud which, as we have come to realize, marks the deeper and denser portions of the Milky Way. Above these is the tangled mass of Ophiuchus and Serpens, and higher, in the zenith, are Hercules and Corona. To the east are Lyra, Cygnus and Aquila—another very fine region. Lower down, in the northeast, we find Cepheus and Cassiopeia. Draco and Ursa Minor are high in the north, with Ursa Major in the northwest, Leo low in the west, and Boötes high. Virgo is the only prominent constellation in the southwest; but Jupiter and Saturn brighten up this region very considerably at the present moment.

The Planets

Mercury is a morning star all the month, and should be easily seen during the last half of it. He is in elongation on the 22nd, 22 degrees from the sun, and rises before 3:30 A. M.

Venus is also a morning star, and close by. The two planets are in conjunction on the 21st, though not very closely. Mercury being nearly three degrees south of Venus. On the 23rd, both are near Aldebaran. Mercury being about two degrees north of the star, and Venus 2½ degrees north of her sister planet. Mercury is brighter than Aldebaran, but will probably not look so, being overshadowed by Venus, which is forty times brighter.

The spectacle will be a pretty one for the early risers. Mars is an evening star, and sets only about an hour later than the sun; hence he can hardly be seen.

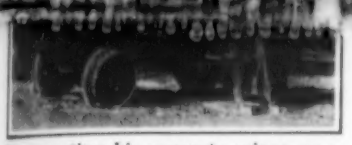
Jupiter is on the borders of Virgo and Libra, and comes to the meridian at 9 P. M. in the middle of the month. Saturn is in Virgo, and souths at 7:20 P. M. on the same date.

Uranus is in quadrature west of the sun on the 8th, and is observable in the early morning. Neptune is an evening star in Cancer, setting about 11 P. M.

The moon is in her last quarter at 4 A. M. on the 6th, new at 7 A. M. on the 14th, in her first quarter at 4 P. M. on the 21st, and full at 8 A. M. on the 28th. She is nearest the earth on the 25th, and furthest away on the 9th. During the month she passes near Uranus on the 6th, Venus and Mercury on the 12th, Mars on the 15th, Neptune on the 18th, Saturn on the 22nd, and Jupiter on the 24th.

At 6 P. M. on the 22nd, the sun reaches its greatest northern declination, and enters the "sign" of Cancer—at which time, by the familiar almanac reckoning, summer commences.

Princeton University Observatory,
April 7, 1923.



By mounting his concrete mixer on a motor truck, this contractor gains time

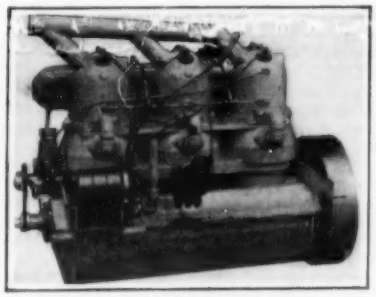
Concrete Mixer Moved Economically

WHEN Mr. Stanley Carman, masonry contractor of Woodmere, Long Island, had a little difficulty in the transportation of his concrete mixer, he hit upon the idea of mounting it on his four-wheel drive truck. He also mounted 10-inch steel flanges on the front wheels of his truck and 12-inch flanges on the rear wheels. These, he claims, enable his truck to go over soft ground which is frequently encountered in going onto many jobs. When Mr. Carman is ready to move his mixer from one masonry job to the next, he merely cranks the truck and away he goes. The motor truck cuts down the moving time between jobs considerably and facilitates the placing of equipment in just the location where it can be used to the best advantage on the job. One marked advantage of trucks having the power transmitted to all four wheels is the superior tractive ability which makes them well suited for contracting and construction work of all kinds. This is especially true at the starting of operations, when ground is rough or soft and also in excavating work, before an opportunity has been afforded to lay even a temporary roadbed.

New Automobile Motor

A NEW motor that seems to be well adapted to motor truck service is a combination of three engines—steam and two- and four-stroke cycle gasoline motors. The inventors claim the good points of each are retained, and disadvantages eliminated. As soon as the engine starts to operate, it begins to generate steam by the heat of the exhaust gases that in all former type of gasoline motors are a total waste. The steam that is generated in this manner is used to scavenge the cylinders of dead gases and eliminate carbon at the same time. The steam generator does three things at one time, viz., generates steam, cools the hot gases, and forms a muffler all in one unit.

The motor illustrated herewith is two-cycle in operation, firing the gas in every cylinder at every revolution of the crankshaft. The inventors claim that disadvantages of the former two-cycle engines are entirely eliminated, stating that the engine cannot backfire. There is no mixing of gasoline and oil together as is the case with most two-cycle motors as no base compression is used to transfer the charge. The oil splash lubricates as is the case with all four-cycle engines, but the complicated parts of the four-cycle motors have also disappeared in this motor. As the cut has but sixteen complete interior working units. The only working parts are the pistons, connecting rods and crankshaft. Having a compression cylinder in place of crank case compression, this surrounding the firing piston, the loss of gas through bearing is eliminated, and there is effected a material saving of oil over the four-cylinder type, because but half the number of firing



A combination of three engines—steam and two- and four-cycle gasoline engines

cylinders are used to produce the equivalent turning moment of the four-cycle type.

The first working model three-cylinder motor replaced a six-cylinder motor of standard make and is six inches shorter and one hundred pounds lighter, yet the motor shown is all cast iron while the other had an aluminum base and other parts. In upkeep expense the inventors believe the new motor will be in a class by itself, as the only moving parts are the pistons, connecting rods and crank shafts, while the construction expense will be greatly reduced.

Cost of Snow Removal

ACCORDING to the best authorities, snow from 12 to 36 inches, if not too heavy, can be moved by motor trucks, with plow attachments, with excellent results. Trucks should be run on opposite sides of the highway for return trips and should not be operated at more than four miles per hour. A few men should be carried to shovel away the wet snow that piles up in front of the blade. While it is impossible to estimate what snow removal on the highway costs per mile throughout the nation as a general average, on one section, which is typical, under the most severe conditions the cost ranged from $75 to $350 per mile, while in a milder winter the cost was but from $10 to $30 per mile. Certainly this is a very small cost in comparison with the needs of the nation for adequate highway transportation all the year, apart from the usefulness of snow clearing in helping to maintain improved roads.

It is expected that proper organization will make it possible to keep all main or trunk-line highways open for traffic all the year round. The only thing to do is to divide the road into districts and have adequate snow-removal equipment plows.

Gasoline Lift Truck for Factory Use

SOMETIME ago a well-known manufacturer of gasoline engine propelled industrial vehicles announced the production of a small tractor for use in inter-department transportation in factories, this being designed so it could pull loaded trailers between buildings and into the shops. A new lift truck is now in production that offers a number of advantages for shop use not possessed by the tractor-truck type. The Truklift conforms in appearance and uses to the electric elevating lift trucks which have been used in industrial plants for many years, but low initial cost, ease of maintenance, flexibility and continuous twenty-four-hour service are distinguishing characteristics claimed for it by the builders.

The loading platform is 26 inches wide by 54 inches long and will elevate its load of 4000 pounds from a minimum of 11 inches to a maximum of 16 inches from the floor in eight seconds; automatic stops provide for both up and down limits; elevation can be stopped by hand-control lever at any point. The total weight, ready to go to work, is

Typical snow plow used in connection with a standard motor truck

2500 pounds; over-all length of machine is 107 inches; width 35½ inches and height 51 inches. The driving and elevating controls are mounted on the rear of the engine compartment and are operated by the driver, who drives standing. The brake lever pedal is under the operator's foot and so arranged that the machine stops automatically if for any reason the operator steps off while the machine is running.

The lifting mechanism is operated by hydraulic pressure. Power for locomotion and elevating the load is derived from a 15-horsepower, 4-cylinder tractor engine with a 3¼-inch bore and 4½-inch stroke. The engine is mounted at the rear in a closed compartment, containing transmission, governor, vacuum tank, radiator and other parts. A three-point suspension is used, the steering wheel forks being supported in a steel casting which is pivoted at the center of the

S. A. E. Discusses Methods of Gasoline Conservation

THE research department of the Society of Automotive Engineers has forwarded to Washington a statement for the consideration of the La Follette Senate Committee which is investigating the gasoline situation. The society declares that fuel conservation can be had by improved carburetion, improvement in gasoline, better engines and education of the user. The factors which promote fuel economy are summarized as follows:

"(1) Universal adoption of means for maintaining the engine and the carburetor and intake system at the best operating temperature.

"(2) The adoption as rapidly as possible of carbureting devices which can be adjusted once and for all by the maker to supply automatically a correct amount of fuel as completely atomized as possible for economical operations under all conditions.

"(3) An economically correct grade of gasoline supplied uniformly throughout the country but suitably varied, if possible, to meet climatic conditions.

"(4) Education of the user of motor vehicles to the advantages which will accrue to him through fuel economy.

"(5) The gradual adoption of engines using higher compression ratios with resulting higher fuel economy.

"(6) Servicing of automotive equipment to maintain it in satisfactory condition for economy of operation. This refers to the entire vehicle as well as the engine, and present conditions can be improved by education of the public and of the garage mechanic, and by improvements in the service facilities offered by the dealers.

"All these factors, except, perhaps, the education of the general public, are receiving a continually increasing amount of study by the Society of Automotive Engineers and the manufacturers, and we believe that much has already been accomplished in eliminating fuel waste. The necessity of meeting popular demands inconsistent with economy, and the difficulty of putting new developments into immediate production have retarded this accomplishment."

Small gasoline lift truck employed for inter-department transportation in modern factories

Recently Patented Inventions

Brief Descriptions of Newly Invented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.

Pertaining to Aeronautics

FLYING MACHINE.—W. L. BUSWELL, Amarillo, Texas. This patentee has in view a flying machine having various features designed to make it readily responsive to the operator. The machine includes provision to bodily move the wings and duplicate as nearly as possible the action of a bird, to provide for varying the angle of the wings, so that the inertia of the machine may be overcome and sufficient momentum acquired prior to inclination of the wings to permit of a ready "Take off," as well as to move the wings out of the horizontal plane so as to effect a natural "banking" without strains. The entire rear portion or tail is made capable of moving in the manner of a bird in flight. (See Fig. 1.)

Pertaining to Apparel

SHOE CONSTRUCTION.—P. F. MCNULTY, 250 Fifth Ave., New York, N. Y. The invention contemplates the provision of shoe scientifically constructed to effect the proper and natural growth of the foot of the wearer, the sole being constructed in such a manner as to properly support the arch of the foot, and to distribute the weight of wearer at the proper points of contact, and to provide means for separating the great toe from the next adjacent toe in order to prevent malforming of the other toes.

COLLAR.—J. J. EAGAN, New Castle, Pa. The object of the invention is to provide a collar of the so-called turn-down type with a novel form of buttonhole on the under tab, adapted to facilitate the buttoning of the collar about a person's neck and properly adjusting the same after being buttoned. A further object is that the buttonhole be adapted to permit locking the associated collar button in adjusted position. (See Fig. 2.)

GARMENT SUPPORT.—T. L. CAUDLE, Wadesboro, N. C. The foremost object of the invention is to provide a device for supporting trousers from the shirt of the wearer, by which the use of suspenders may be dispensed with and a belt worn for appearance only. A further object is to provide a support comprising a pliable base suitably mounted on the inside of the trousers, with a resilient supporting member stretched between its extremities, the base preventing excessive contraction, thereby avoiding the puckering of the trousers.

HEAD PROTECTOR.—H. E. TURPIN, c/o St. Mary's College, Oakland, Calif. The general object of this invention is to provide a resilient protecting device concealed within a hat to protect the head of a wearer from sudden blows. A further object is to provide a device which will be light in weight, automatic in operation, durable in use, and will not interfere with the appearance of the hat.

Electrical Devices

WINDING REEL.—S. B. BENNETT and D. MCCORMICK, Bend, Ore. This invention relates principally to reels for electric wire, but can be used for the winding of air or water hose, the principal object is to provide a reel which may be used for winding the intermediate portion of a line to shorten the length of the line without disturbing fluid flow, or the passage of an electrical current through the line which is wound. The device is particularly adapted for use in connection with a telephone or other flexible line.

MAGNETIC INTERLOCKING REPEATER.—C. J. ROGERS, Great Western Electric Co., Morris, Okla. This invention relates to telegraph relays or repeaters. One of the principal objects is to provide a repeater wherein the continuity of the transmitting circuit connections is preserved after the termination of an electrical impulse in the transmitting circuit, by means of mechanical action, and not by means of a holding coil or other equivalent electrical means.

REFLECTOR.—I. LITNER, 494 Gates Ave., Brooklyn, N. Y. The invention relates to a reflector capable of receiving a globe as well as an ordinary electric lamp. An object is to provide a reflector having more than one reflecting surface, one surface intended to reflect the light emitted by the bulb and the other to reflect the light emitted by the globe which receives the reflected light of the bulb. (See Fig. 3.)

WINDING DEVICE FOR DROPLIGHTS.—C. V. JOHNSON, 1595 Haight St., San Francisco, Cal. Among the objects of the invention is to provide a simple supporting and winding means for droplights, and to make the complete device readily portable and adapted to be hung up in a particular location when needed, and to provide a guide for the conductor cord to guard the cord in all directions in its movements into and from the casing of the winding mechanism.

Of Interest to Farmers

QUEEN-EXCLUDING HONEY BOARD.—D. G. LITTLE, Hartley, Iowa. Among the objects of this invention is to provide a honey board arranged to be placed between the super and the brood chamber of a beehive, to prevent the queen from entering the super chamber and depositing eggs among the combs, when it is desired to obtain pure honey. An important object is to provide special means for constructing and fastening the board.

VACUUM ASPIRATOR.—E. T. DRAKE, c/o G. E. Reed, 1-4 Batts Bldg., Fostoria, Ohio. The invention relates to aspirators for grain. The object is to provide a vacuum aspirator which is especially adapted for use in the handling and manufacturing and for aspirating and purifying grain, such as wheat, corn, rye, oats, barley and grain by-products, and which is of simple and durable construction and inexpensive to manufacture.

FARM TRACTOR.—O. L. LEWIS, 7358 Rhodes Ave., Chicago, Ill. The invention relates generally to farm tractors of the front wheel driving type. The primary object is to provide a tractor capable of pulling agricultural implements, vehicles and the like, and adjustable to provide the required overhead clearance for orchard cultivation, permitting its ready passage beneath branches of trees, and permitting the final cultivation of high growing crops such as corn, cane, cotton and the like.

PLOW ATTACHMENT FOR TRACTORS.—B. W. MORTON, Williston, Fla. The object of the invention is to provide means whereby a plow of the landside type may be directly attached to a tractor and disposed so that it may be observed by the driver of the tractor during operation. A further object is to provide means for eliminating the possibility of breakage in case the plow should meet with a well anchored obstruction.

GATE AND OPERATING MEANS THEREFOR.—A. G. MAASDAM, 2017 Manderson St., Omaha, Neb. This invention refers to operating mechanism for gates, and is especially adapted for farms and rural districts to control an entrance on a roadway where it is inexpedient to plant a post, the gate being mounted to swing from one side of the line of fencing and adapted to be actuated at a convenient distance so as to be opened when approaching and closed after passing without dismounting from a vehicle.

HEN'S NEST.—C. A. PARFREY, Richland Center, Wis. An object of this invention is to provide a device which is collapsible so that it may be readily opened up for the purpose of cleaning and disinfecting. A further object is to provide a nest formed almost entirely of wood, which will occupy a comparatively small amount of space when being shipped, and which is so simply constructed that it may be readily assembled and disassembled.

Of General Interest

MOLD—G. H. GERAERDTS, 1445 Boone Ave., Bronx, N. Y. The invention particularly relates to a mold for producing window sills of cement or other plastic materials, the sills being provided on the upper face with an inclined depression constituting a drain and on the under face adjacent the edge with a groove for preventing water from passing over the window sill and from flowing onto the wall of the building. The invention aims to provide an adjustable mold for producing sills of various sizes.

REEL—A. E. JENKS, Thackery, Ohio. Among the objects of the invention is to provide a reel for fishing rods having means whereby the same may be collapsed when not in use, and means whereby the wear on the arms or spokes may be taken up as occasion requires, and whereby the line supported thereby may be readily dried. The reel is of simple construction and may be inexpensively manufactured.

PROCESS FOR PLATING METAL ON NON-METALLIC SURFACES—E. F. DIETRICH, 1315 Leland Ave., Chicago, Ill. This invention relates to a process for plating metal on non-metallic surfaces, such as china, porcelain, glass, or the like. An object is to provide a process in which metals, such as silver, gold, or nickel, may be permanently deposited by an electro-plating bath an impervious glue being employed for supporting the current conducting substance, the process is such that the metal deposit will not become loosened by heat or moisture.

SCALP APPLIANCE—E. A. FARROW, 5040 Grand Blvd., Chicago, Ill. An object of the invention is to provide a device for stimulating the growth of the hair by providing a partial vacuum adjacent the scalp for releasing dandruff and removing the loose dandruff to a suitable compartment, and for removing short, broken, or loose hairs from the scalp, which are not easily removed by brush or comb. A further object is to provide a device which may be kept in a sanitary condition.

LADDER.—J. H. DWIGHT, 479 Stewart Ave., Atlanta, Ga. The invention relates more particularly to the rungs of ladders. An important object is to provide a ladder rung which may be readily and conveniently applied to the sides of a ladder in such manner that the loosening or loss of the rung is absolutely prevented, the rung is adjustable and the spaces may be varied as desired.

BOOKSTAND.—F. M. PRIEST, Rusk, Texas. An object of the invention is to provide a bookstand which will be particularly useful in county clerks' offices and other places where it is necessary to copy from or make entries in large heavy books or manuscripts. A further object is to provide a stand of this character, in which the book supporting member is adjustable both vertically and angularly, and a stand which will be strong and durable in use, and comparatively inexpensive to manufacture.

POT PROTECTOR.—J. V. JEWELL, 935 Dawson St., Waterloo, Iowa. Among the objects is to provide a protector which will support a coffee pot over a gas burner in such a way that there is no danger of blackening the sides of the pot, or the handle becoming scorched or overheated while the pot is on the fire. A further object is to provide a device which is simple, strong, and may be conveniently shifted from one burner to another while it is hot.

MILL BASKET.—H. L. SMITH, Smith Mfg. Co., Dalton, Ga. The general object of the invention is to provide a basket for use in mills, employing canvas and a stiffening frame in the structure, and having means for giving the basket a knock-down form, and so arranged that the stiffening rim is detachably secured to uprights which themselves are removably secured to a base.

WINDOW.—S. U. BARR, c/o W. H. Jackson Co., 335 Carroll St., Brooklyn, N. Y. An object of the invention is to provide a window arranged to permit of easily and conveniently moving the sashes into open or closed position and to render the window completely dust and air and watertight when the sashes are closed. A further object is to prevent rattling of the lower sash in whatever position it may be, and to prevent its being raised from the outside.

HAT TRAY.—J. S. BOOTH, 816 So. Haskell Ave., Dallas, Texas. The invention particularly relates to a tray adapted for use with straw hats. The object is to provide a tray which will safely pack or crate a relatively large number of hats in a compare-

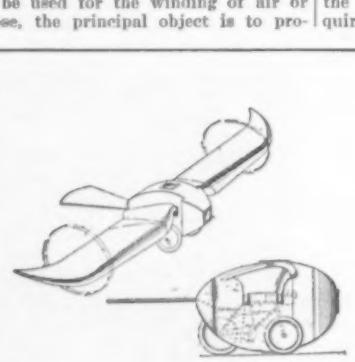


Fig. 1. W. L. Buswell's invention makes the flying machine highly responsive to the operator

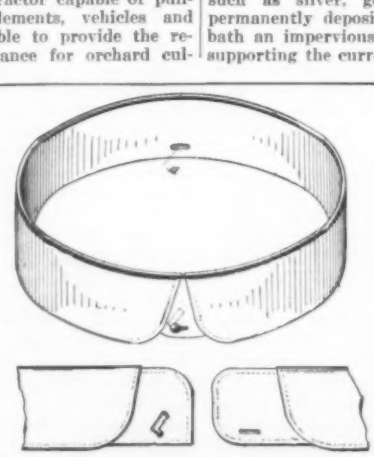


Fig. 2. A collar which can be buttoned without a tussle, is the invention of J. J. Eagan

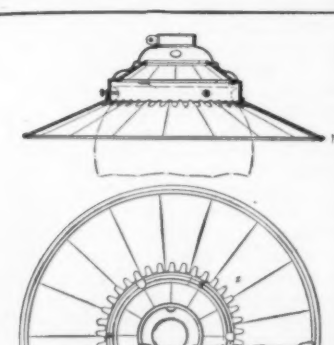


Fig. 3. To heighten the reflecting efficiency of the light, I. Litner has invented this combination reflector

tively small space and in trunks as is the practice among traveling salesmen. The device is adjustable and capable of use with various styles and sizes of hats, it is also of simple and durable construction.

DRAW LATCH.—O. M. STEVENS, Burke, Idaho. The general purpose of the invention is to provide a latch for a draw that will exclude children without the necessity of locking the draw and yet will enable the draw to be unlatched and opened by adults with facility and dispatch, the unlatching device being associated with a turntable handle-bar supported in brackets.

CLASP.—D. H. NEILLY, 22 Chamber St., Bradford, Pa. The object of the invention is to provide a clasp especially adapted for use with rifle straps or the like, which is of simple and durable construction and which automatically exerts a powerful gripping action upon sections of the rifle strap to maintain it in desired position, the device is easily adjusted and is quickly and uniformly effective in any position.

ENVELOPE.—C. O. STEMEN, 54 Watson St., Detroit, Mich. The invention relates more particularly to an envelope of that type adapted for use where a reply is anticipated or for commercial use where an envelope is placed inside another envelope, the device serving to obviate the necessity of employing two different sizes of envelopes, thus resulting in a great saving of paper. The envelope is folded in such a way as to constitute a sending and return closure, with the return address printed to avoid mistakes.

SECTIONAL BOAT. — A. E. OLSON, Holton, Mich. An object of the invention is to provide a boat made up of a plurality of detachably secured sections adapted to be disassembled and packed into small compass for storage or transportation, and assembled at will without the use of any tools, to form a boat of ordinary construction. A further object is to provide a knock-down boat, the sections of which are arranged in nested relation whereby they may be supported upon the running board of an automobile.

DISPLAY STAND.—W. J. DODD, 442 W. Main St., Lexington, Ky. Among the objects is to provide a display stand affording facilities for releasably holding a plurality of boxes or containers in position to display the contents of such boxes or containers to best advantage. The device is of simple construction, and will take up but little space in a store.

BUNDLE PROTECTOR.—E. L. BRUCE, Jr., 319 Ridgeway, Little Rock, Ark. This invention has for an object to provide a device which can be readily applied to bundles of strips or the like, to protect the same during the handling incidental to shipment. A further object is to provide a device that can be produced cheaply and therefore be discarded with but slight loss when out of service.

PEANUT BUTTER AND PROCESS FOR MANUFACTURING THE SAME.—J. L. ROSENFIELD, 1916 Webster St., Alameda, Calif. This process comprises pressing the major portion of the oil from the peanuts and removing the same therefrom, comminuting the resultant cake or mass, hydrogenating the oil thus removed, reincorporating the hydrogenated oil with the comminuted mass and adding salt thereto while mixing the same. The process does not require the use of machinery other than that usually employed.

FOLDING TABLE.—E. E. MCGREW, 2124 Y St., Lincoln, Neb. An important object of the invention is to provide a folding table which is constructed entirely from metal so that the same will not warp or crack as the result of being subjected to dampness or to the strains incident to transporting the same in its folded position. A further object is to produce a table which may be quickly set up, provided with no detachable parts and which will occupy a small space when folded.

WEATHER STRIPPING FOR DOORS.—F. J. KENNARD, Box 831, Beggs, Okla. Among the objects of this invention is to provide means whereby a threshold may be carried by the door with which the same is associated and automatically raised and lowered with the opening and closing of the door respectively, the device is so constructed that it is not likely to get out of order.

AUTOMATIC STOPPING ATTACHMENT FOR PHONOGRAPHS.—B. W. GARDNER, Box 1474, Indianapolis, Ind. The invention has for an object the construction of elements which, used in conjunction with two moving parts of a phonograph, will effect an automatic stopping of the machine when the stylus, carried by the tone arm, reaches the end of a record groove. A further object is to produce a simple device which requires no attention once the mechanism is put into action.

WINDOW SCAFFOLD. — M. DWORK, 2236 78th St., Brooklyn, N. Y. An object of the invention is to provide a safe and reliable support for persons employed in the dangerous task of cleaning the outside of windows. A further object is the provision of a support which furnishes not only a comfortable seat but sufficient room for conveniently holding articles for use in the work and a safeguard against accidental precipitation from the support.

SLED.—L. H. M. LUHRS and A. H. PASSBACK, 2641 Jerome Ave., Bronx, New York. This sled comprises a curved bottom board and an adjustable seat frame which may be adjusted to accommodate the individual using the sled, a handle attached to the seat frame serving as a balancing means, and an adjustable foot rest on the bottom board to serve as a bracing means for the user.

EXPOSURE METER.—F. MELLA, Casilla 3244, Santiago, Chile, S. A. The invention aims to provide a meter adapted for use in taking photographs. The object is to construct a device by means of which an amateur may set various elements to correspond to known conditions, whereby to obtain a final reading which may be implicitly relied upon to produce a perfect result in photography.

BOTTLE CLOSURE. — H. IPSEN, 69 Liberty St., Brooklyn, N. Y. An object of the invention is to provide a bottle cap so constructed that it may be easily applied or removed without the use of tools. Another object is to provide a cap of the crumped type wherein one part of the cap acts as sealing means and the other as locking means, the whole being applied or removed by hand.

PACKING CASE. — H. H. READ, 84 Cranley Gardens, Muswell Hill, London N. 10, England. The invention relates to packing cases of the kind which are bound with strips of iron disposed in grooves, and has for its object to provide means for preventing pilfering during transit of goods in the case. According to the invention hoop iron binding strips are secured around the case in the grooves, by means of rivets, wire or the like, the outer ends being sealed by soldering or the like.

PEN.—R. J. ESTES, Coalgate, Okla. The general object of the invention is to provide a writing pen employing a stylus having a tapered front end, and an element with which the stylus has threaded engagement for longitudinal adjustment by the turning of the staff of the pen, and a feed control means at the front end through which the stylus may be projected.

CONTAINER CLOSURE AND POURING SPOUT.—P. A. BALISON and I. G. STATEROPOULOS, 596 Palisade Ave., Grantwood, N. J. The invention relates to sanitary dispensing closures for milk bottles and similar vessels, an object being to provide a device which not only prevents the entrance of extraneous matter into the milk but which will facilitate the pouring. A further object is to provide a device which may be quickly and firmly applied and very readily sterilized.

RECEPTACLE.—J. RAGGIO and F. BONGIORNI, 617 53rd St., Brooklyn, N. Y. One of the principal objects of the invention resides in the provision of a receptacle for drinking water which includes a separate compartment for ice as a cooling medium, whereby the practice of placing the ice directly in the water is eliminated. The invention further aims to provide means for drawing off the water from the melted ice without emptying the receptacle proper.

BUILDING TILE.—A. H. ROETH, 105 Mount Hope Place, Bronx, N. Y. Among the objects of the invention is to provide an interlocking tile provided with both vertical and horizontal air spaces which will prevent moisture from seeping through the wall, the air spaces being provided between every mortar joint so that if the outside joint absorbs moisture there is no danger of it seeping through.

STORE CABINET.—W. P. WALKER, c/o Wilson Drug Store, Spartanburg, S. C. Among the objects of the invention is to provide more particularly a floor cabinet for stores, which will combine storage and display fixtures in such manner as to preclude ready disturbance of the display arrangement after they are once made, and will at the same time admit of convenient access when the arrangement of the goods are desired to be altered from time to time.

SWIMMING SHOE.—V. DAHLER, c/o Noack, 977 Grant Ave., Bronx, New York. The invention relates to a simple accessory for swimmers. An object is to provide a swimming shoe which includes hingedly connected blades which function to increase the propelling area of the foot during the rearward movement, and which are foldable during the forward movement of the leg and foot to decrease the area of resistance.

NEPHOSCOPE.—A. MCADIE, Harvard University, Blue Hill Observatory, Readville, Mass. This invention relates to an instrument for facilitating the measuring of the velocity of cloud travel and designating the direction of such travel, it comprises a plane mirror for reflecting a cloud image, a rod for establishing a line of sight between the mirror center and a point on the cloud, and a quadrant along which the sighting rod is adjustable, having the natural tangents of the angles formed by the sighting rod and mirror graduated and marked thereon.

ANIMATED FIGURE.—MAGGIE B. CONWAY, 833 Main St., Danville, Va. This invention relates to animated figures and has for its object to provide a figure adapted to partake of original and unusual movements and actions to attract attention and amuse observers, whereby it may be used either as an advertising device or a toy. The device is simple, durable in construction and easy and inexpensive to manufacture. (See Fig. 4.)

VENTILATOR.—A. PAJALIC, c/o Mich. Metal Enrichment Co., 11739 Kercheval Cor. and Hart Ave., Detroit, Mich. An important object of this invention is to provide means for rotatably supporting the body of a ventilator so that the same may freely rotate as the result of the passage of air through the same. A further object of the invention is to provide a ventilator which is quiet, efficient in operation and inexpensive to manufacture.

VANITY CASE.—W. G. KENDALL, 118 Market St., Newark, N. J. An object of the invention is to provide a vanity case which will securely retain a carrier, for rouge or other cosmetics, in place on the bottom of the case, and to provide a form of carrier so constructed that it will not interfere with the cosmetic packing operation. A further object is to provide a case which will be neat and attractive, and inexpensive to manufacture.

GOPHER POISONER.—W. J. MERVYN, Box 80, Cliff-Hamilton, Saskatchewan, Canada. The invention particularly relates to poison distributers. An important object is to provide means whereby a predetermined quantity of poisoned grain or the like may be discharged from the distributer at will. A further object is to provide a distributer which is simple, efficient and cheap to manufacture.

SNOW REMOVING SYSTEM.—W. F. GUERIN, 1914 69th St., Brooklyn, N. Y. This invention contemplates a snow removal system which includes trenches located adjacent the gutter of a street in which heating pipes are arranged for maintaining a predetermined supply of water at a sufficient temperature to immediately melt the snow introduced to the trenches. A further object is to provide the trenches with normally closed removable covers, and with overflow and cleanout conduits communicating with the sewerage system of the city. (See Fig. 5.)

CIGARETTE CASE.—G. H. SPENCER, c/o Collison & Co., Glen Osmond, South Australia, Australia. This cigarette case comprises a thin flat metal case having in one side a removable cover and within the other side an ejecting device, said cover carrying a compression plate attached by means of a spring, and the ejecting device for removing the cigarettes one by one, comprises a spring-operated slidable rod carrying upon one end a shutter and upon the other end an ejecting plate.

AUTOMATIC STOP FOR PHONOGRAPHS.—A. ROGATI and L. ARONNE, Kimberley Phono Co., 226 Fayette St., Perth Amboy, N. J. Among the objects of the invention is to provide a brake for cooperation with the turntable of a phonograph, said brake having devices associated therewith to initiate the gripping action thereof automatically according to the position to which the tone arm of the machine has approached in the normal running operation of the machine.

HOLDER.—H. BERLOW, c/o Maxwell Brushes, Inc., 496 East 134th St., New York, N. Y. The invention aims to provide a holder primarily intended as a support for bathroom appliances, such as an ordinary tube used in connection with a spraying attachment for a faucet, and by means of which said attachment will be supported in such manner as to preclude of its being accidentally detached from the holder, or injury occurring to the tube during its suspension.

MAILING DEVICE.—J. T. MCKENZIE, JR., 117 Hillcrest Road, Ridgewood, N. J. The object of the invention is to utilize an envelope, containing a letter of instructions, sent out at the same time as the catalog or the like, to hold them closed while carried by the mail, thus assuring the arrival of the two at the same time. A further object is the provision of a holder which may be opened by the postal authorities to examine the catalog.

BURIAL VAULT.—A. J. HOPKINS, Box 146, East Orange, N. J. An object of the invention is to provide a base or support which is adapted to support a casket in a burial vault above the bottom or floor of the vault, and to drain any moisture that may collect in the vault from underneath the casket, whereby the casket will be protected from any moisture within the vault.

DISPENSING DEVICE.—L. W. TIFFANY, Winsted, Conn. The invention aims to provide a dispensing device particularly intended for use in connection with pins and paper clips, but not necessarily limited to this adaptation, and by means of which primarily, an extremely neat appearing article will be produced which will present the elements to be dispensed in such a manner that the same are readily accessible.

EXPLOSIVE CONTAINER.—W. BECK, address G. C. Shillers, Atty., Tulsa, Okla. This invention relates to explosive containers for use in oil and gas wells. An object is to provide a container consisting of inner and outer shells, the outer shell forming a means for protecting the inner shell from frictional contact with the wall of the casing, and also to prevent the inner shell from being punctured, and prevents any explosive which might escape from the inner shell, from causing a premature explosion.

ROLLER.—R. D. SCOTT and J. G. CADWELL, Box 944, Roslyn, Wash. The object of the invention is to provide a roller for preventing moving ropes or cables from en-

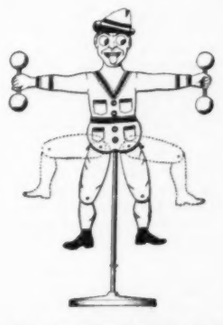


Fig. 4. This toy and animated advertising device is the product of Maggie B. Conway, patentee

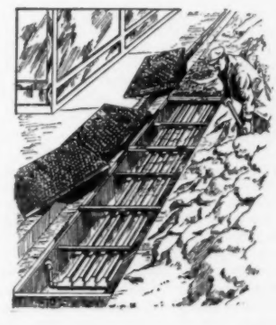


Fig. 5. Removal of snow by melting on heating pipes, is the invention of W. F. Guerin

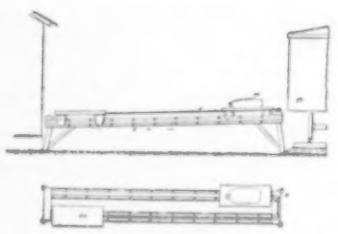


Fig. 6. This gravity conveyer is the invention of C. O. Ekstadt

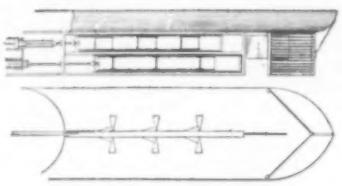


Fig. 7. A new propeller of high efficiency is the patented discovery of A. E. Beebe

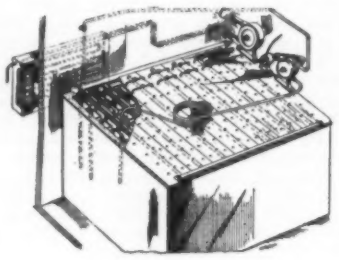


Fig. 8. By the use of this device invented by R. W. Taylor, a saving in power is effected

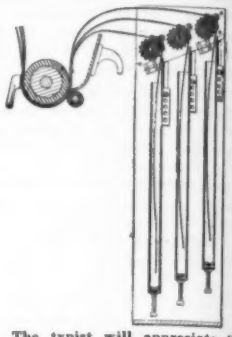


Fig. 9. The typist will appreciate this ingenious device invented by W. C. Avery for speeding up work

gaging the ground, and is of such construction that the life thereof, as well as the life of the rope which may be engaged therewith will be relatively prolonged. It is also an important object that the roller be of such shape that in case the rope leaves the one end thereof that the same may be again easily positioned.

ROPE STRUCTURE.—F. RIESENBERG, c/o Whitlock Cordage Co., Jersey City, N. J. The primary object of the invention is to provide a rope in which a more even distribution of the work performed by the individual elements of which the rope is formed may be had. It is a further object to provide greater strength and flexibility in the larger sizes, and to provide a strand which may be employed in the manufacture of three, four or more stranded rope, and form a rope in which the internal friction will be reduced.

REEL.—C. M. RODGERS and A. W. WENGER, c/o Wenger Mfg. Co., Warsaw, Ind. This invention relates to fishing reels used in casting operations, and the object is to provide a reel adapted to hold a line so that air is permitted to circulate freely about the coils of the line to dry the same. A further object is to provide a reel formed from a single piece of metal, and having means for controlling the rotative movement of the line.

REFRIGERATING APPARATUS.—L. R. POSCHADEL, 155 Garfield Ave., Milwaukee, Wis. Among the objects of the invention is to provide a system by means of which cooling of refrigerators, storage rooms or the like may be accomplished without the use of ice. A further object is to provide a system which can be economically operated due to the fact use is made of city water distributing system, the water being run into water jackets in the cooling room whenever the faucets are opened.

PROCESS FOR PRODUCING SOUND WAVES.—E. REISZ, Fehlert, Berlin-Zehlendorf, Germany. This invention relates to a process for producing sound vibrations in moving pictures on a single film, and has for its object, to intensify at will the loudness of the sounds and to use a positive film in its customary form, that is to say, with a gelatine layer sensitized to light. A further object is to record two or more simultaneously created systems of sound waves, as for example when a song is to be sung to an accompaniment.

Hardware and Tools

PAPER PUNCH CLEANER—C. B. FOWLER, 9422 215th St., Queens Village, L. I., N. Y. The invention relates to a cleaning device for paper punches and has for an object the provision of means whereby the paper is prevented from sticking in the punching apparatus. Another object is to provide means whereby the cleaning action takes place entirely automatically during the manipulation of the punch, and does not in any way prevent the centering of the punch on the proper point.

HINGE—D. MCNEILL, Ritter Bldg., Room 6, Huntington, W. Va. This invention has for its object to provide a construction of hinge pin having a longitudinal lubricant containing groove therein which serves to lubricate all the movable parts of the hinge and can be readily removed, cleaned and refilled from time to time. The device can be manufactured and sold at a cost the same as ordinary hinges.

DOOR LATCH.—R. G. WILLIS, 907 W. Main St., Chanute, Kan. The invention aims to provide a door latch having a pivotal latch member which may be conveniently operated from either side of the door and which is provided with a housing for preventing cattle, horses or other stock from operating the latch, the housing or hood also serves to protect the latch from snow and ice which frequently render a door latch inoperable. A further object is to provide a latch which can be applied without mutilating the door.

SCRAPING DEVICE.—J. M. GOUBIER, Usine de la Chaussee par Aulnay sur Mauldre, Seine et Oise, France. The invention has for its object a scraping tool applicable as a carpet scraper. The device comprises an element constituted by a prismatic strip of rubber and cloth, having two rectangular plane faces and a convex face, and means for maintaining the said strip so as to leave free one of its edges to form a scraping edge.

CLAMP.—J. BROOKS, 2505 Walnut St., McKeesport, Pa. An object of the invention is to provide an adjustable clamp in which two clamping brackets are connected by a chain which is quickly adjustable to enlarge or contract the clamp in accordance with the work to be done. A further object is to provide a clamp which when not in use can be packed in a relatively small space, and which will be strong and durable in uses.

HAIR-CUTTING DEVICE.—J. GIERLASKI, 911 N. Newton St., Chicago, Ill. Among the objects of the invention is to provide a device in which the blades may be removed for sharpening, and in which the guard may be moved to vary the depth of the cut, that is, to either leave the hair short or long. The device is compact in form, and provided with a guard member to protect the scalp.

PLANE.—E. J. SWEENEY, 707 South Winnebago St., Rockford, Ill. An object of this invention is to provide an arrangement for setting the bit. Further objects are to provide a simple construction wherein the bit may be readily fed forwardly or rearwardly and when adjusted automatically locked in position, the same being associated with a guide to always hold the parts in operative position.

NUT LOCK.—F. L. BATES, 1234 Harbert Ave., Memphis, Tenn. The invention particularly relates to an arrangement of threads within a nut whereby a portion of the threads of the nut serve to expand or distort threads of a bolt and provide a nut lock without the employment of any third part. An object is to provide a form of nut especially adapted for use in connection with railroads.

WIRE EMBEDDING TOOL.—R. S. BENSON, West Paris, Maine. The invention relates generally to a foundation tool for bee keepers, but more particularly to an electrically heated wire imbedder, which will heat and imbed the wire to a predetermined depth in the foundation, in a simple manner. The invention further contemplates a wire embedding tool which may be used in pairs or singly.

TOOL.—H. H. JONES, 417½ So. Main St., Los Angeles, Calif. An important object of the invention is to provide a tool embodying a chuck having means whereby the jaws of the same may be closed when it is desired to engage the head of a bit. A further object is to provide a tool wherein the operating or gripping handle is employed as a stationary jaw of a wrench, and having means for performing various functions.

Heating and Lighting

SHADE HOLDER.—C. KOHLHAAS, 33 Madison Ave., Long Branch, N. J. Among the objects of the invention is to provide a light shade holder which is compact in form and so shaped that it may be easily placed on the lamp chimney or light bulb without exposing the fingers to the heat of the light, and which may be adjusted to hold the shade at any angle to the light.

BURNER.—P. F. SLOCUM, 106 21st St., Elmhurst, N. Y. The invention relates more particularly to a device adapted to promote the burning of so-called "canned heat." The prime object is to provide a burner which is adapted to be attached to the open end of a container in which this type of fuel is packed for consumption. A further object is to provide a burner which will promote combustion by admitting to the flame the necessary amount of oxygen to cause the flame to burn with the maximum intensity.

SAFETY ATTACHMENT FOR BURNERS.—J. H. REVESON, 800 N. 14½ St., Terre Haute, Ind. One of the foremost objects of the invention is to provide a simple but reliable safety attachment for burners of gas stoves, lamps or the like, which prevents the escape of gas or other fuel from the burner unless such fuel is ignited. A further object is to provide a safety attachment which involves the necessity of applying a lighted match to turn on the gas.

MELTING POT PARTICULARLY FOR STEREOTYPING METAL.—C. WINKLER, Berne, Switzerland. The invention relates to a melting furnace for stereotype metal, comprising two melting pots each having a valve controlled outlet, two adjoining furnaces, one wall of each of which forms a wall of a pot, flues for the furnaces, and a valve for establishing communication between the said flues. The furnace is so constructed that on heating one of the units the waste gases from this can be used to heat the other, in case one becomes defective.

Machines and Mechanical Devices

DIAPHRAGM FOR PRESSURE-CONTROLLING DEVICES.—W. L. HAMILTON, Bangor, Mich. This invention has for its object to provide a diaphragm for pressure controlling devices arranged to provide an exceedingly large throw with a view to render the pressure controlling device exceedingly sensitive to readily respond to the variations in the pressure. The diaphragm is simple and durable, and not liable to get easily out of order.

PORTABLE HOIST.—W. J. HICKMAN, Box 198, Shreveport, La. Among the objects of the invention is to provide a portable hoist for bailing lines having means whereby the same may be quickly set into operation so that the loss of time on the part of the drilling crew will be reduced to a minimum. A further object is to provide a hoist with means whereby the speed may be varied, and which dispenses with the necessity for reeling the drill line from draw works and re-reeling the same line or bailing line each time the well is bailed, thus saving excessive wear on the line.

ADVERTISING DEVICE.—N. WINKLER, Box 556, St. Albans, West Va. The invention relates to advertising devices especially adapted for use in store fronts. An important object is to provide a device having oppositely movable belts upon which figures are mounted to represent an endless line of purchasers entering a store and a similar line leaving the store laden with bundles. A further object is to provide an advertising device having means whereby a plurality of display cards are separably exposed to view.

APPARATUS FOR DISINTEGRATING SEEDS.—A. SCHMIDT, Tegel, near Berlin, Germany. This invention relates to apparatus for rough grinding corn, beans, peas and other cereals, the machine comprises three grooved working members whereof two are stationary and the third is disposed to reciprocate between the two stationary members. According to the invention means may be provided for adjusting the device for altering the size of the crushed particles.

CONVEYER.—C. O. EKSTADT, Orion, Ill. The general object of the invention is to provide a gravity conveyer for conveying of material or goods, in bags, crates, cases, barrels or drums or for cement blocks, stone, etc., the conveyer being characterized by simplicity, portability and by great economy in time and labor, for example in conveying materials from a freight car to a house, more or less distant. (See Fig. 6.)

CARBONATING MACHINE.—J. PELLIPPI, 1235 Second Ave., New York, N. Y. An object of the invention is to provide a construction wherein water and gas are mixed while the water is in a finely divided state. Another object is to provide means whereby the water is automatically fed into the machine as fast as the carbonated water is removed and the feeding in and removal of the water is carried on without interrupting the carbonating operation.

APPARATUS FOR MARINE PROPULSION.—A. E. BEEBE, Box 34, Cathay, N. D. Among the objects of this invention is to provide an apparatus which is adapted to operate either as a tractor or as a propeller and which in either event operates to efficiently propel or drive the boat in such a manner as to develop a maximum degree of efficiency from a minimum expenditure of power. The propellers may be readily reversed without shifting the engine used to drive the same. (See Fig. 7.)

ROTARY PUMP OR MOTOR.—R. N. TRANE, c/o The Trane Company, La Crosse, Wis. An object of the invention is to provide a rotary pump which, unlike most of the pumps of the type, has instead of a line contact, surface contact of relatively considerable area, thereby obviating the disadvantages which arise when the contacting surfaces are worn, and which, in devices of the line contact type, cause the pump to leak after the slightest wear on the line of contact. A further object is the provision of a pump in which the use of an eccentric mass is substantially eliminated, thereby reducing vibration.

ICE-MAKING APPARATUS.—R. W. TAYLOR, 8001 Hickory St., New Orleans, La. One method of freezing blocks of ice in cans is to agitate the water by introducing air which brings the impurities to the center as the block is frozen. The impure unfrozen "core" is removed and distilled water substituted whereupon the freezing of the block is completed. This patentee provides means to utilize the water drawn from the impure core for cooling the incoming air current. (See Fig. 8.)

PAPER FEEDING APPARATUS FOR TYPEWRITERS.—W. C. AVERY, 2320 Vancouver Highway, Honolulu, Territory of Hawaii. A purpose of the invention is to provide a feeding apparatus having paper containing magazines which are disposed perpendicularly and pivotally supported to insure the proper feeding of the paper, and which are vertically adjustable to accommodate sheets of paper of different lengths and to so support the sheets that they will properly co-operate with the feed rollers in effecting the feeding of the sheets to the typewriter. (See Fig. 9.)

POTATO SLICER.—J. EHRHARD, Curtis, Okla. Among the objects of the invention is to provide a device for slicing potatoes or similar vegetables, which will cut the potatoes or other articles to be sliced into

fine pieces, and which is provided with means for slicing the potatoes both longitudinally and transversely. The slicer is strong and durable and sufficiently light to be readily carried about.

MITERING MACHINE.—D. B. OBSHAL, 230 East Main St., Carlisle, Pa. This invention has for its object to provide a novel saw guide and means to variously adjust the guide to cut miters at different angles with convenience and with precision, the saw guide will produce a bevel of any desired angle in the miter.

COMBINED ELEVATOR AND CONVEYOR OF THE STEP OR STAIRWAY TYPE.—J. HENDRY, c/o Collison & Co., Adelaide, South Australia, Australia. The invention has been specially constructed to provide a combined elevator and conveyor of a type which is simple and of inexpensive construction, and which with the use of the same standard parts is capable of great variation in size and design, to adapt it for such diverse trades as bottling, canning and packing factories, restaurants and general warehouse use.

Medical Devices

ECRASEUR FOR THE STOMACH AND INTESTINES.—T. J. F. M. DE MARTEL, 20 Rue de Magdebourg, Paris, France. The invention relates to apparatus for crushing the hollow viscera such as the stomach and the intestines. The device consists of two levers, one having a transverse pin at one end and the other a recess receiving the pin, said recess extending in the direction of length of the lever and leading out through the end of the same, whereby the levers will be pivoted together so that they may be quickly connected or disconnected at any angle.

THERMOMETER. — L. EISELE, 2408 West End Ave., Nashville, Tenn. The invention particularly relates to medical thermometers. The object is to provide a thermometer which is constructed integral with the casing cap and in proper alignment therewith, so that when the cap is inserted in the casing there is no danger of the tube working loose or the thermometer breaking, further this form of stopper, provides a finger grip for removing the thermometer from the casing.

DENTAL FILM HOLDER. — H. G. RALPH, U. S. S. "Chaumont," Postmaster, New York City, N. Y. The invention relates to a device for holding X-ray films in the mouth of dental patients. This film holder is so constructed that when positioned in the patient's mouth and the mouth closed, there will be means of indicating to the dentist the exact position upon which the strongest rays are to be projected, thus insuring a clear and well defined photograph.

Prime Movers and Their Accessories

SPARK PLUG MOLD.—C. E. GERBAUD, c/o Chassevent (Office Desnos), 11 Boulevard De Magenta, Paris, France. The invention relates to molds for use in the manufacture of glass-insulated sparking plugs, by casting the glass insulation in the metal shell of the plug. The object is to provide a mold arranged in such a way as to enable the glass insulation to be cast on to the axial electrode inside the shell without any risk of the formation of cracks in the mass of glass while cooling.

ROTARY GAS ENGINE.—J. H. MCCARTHY, c/o Henry C. Muskopf, 622 Security Bldg., St. Louis, Mo. The object of this invention is to provide an internal combustion engine combining the efficiency of the reciprocal engine with the ease and smoothness in operation of the rotary engine. A further object is to use the reciprocating motions of a piston in a cylinder as a means of compressing the fuel and forcing it into the combustion chamber while the cylinder is passing the latter on a rotary motion.

CARBURETOR.—A. H. WEBBER, 349 Columbus Ave., Boston, Mass. Among the objects of the invention is the construction of a carburetor which shall provide a more desirable "idling" adjustment, and in which the mixture, when the engine is under "load" will embody a more explosive quality, in that a better "intermediate" and "high" speed mixture is provided, and secondly, the individual particles of the same will be more thoroughly subdivided and intimately comingled.

AIR REGULATOR.—R. H. ASHER, London, Ohio. An object of this invention is to provide a device which will automatically regulate the amount of air entering the carburetor, in such a manner that the fuel which is consumed by an internal combustion engine, operated in connection with the carburetor, is considerably less than where such air regulation is not used. The regulator is made in the form of a unit that may be inserted in the air intake pipe without changing either the pipe or the carburetor.

MAIN BEARING LUBRICATOR.—V. W. PAGE, c/o Page Motor Corp., Melrose Ave., Stamford, Conn. The invention relates to lubricating means for internal combustion motors. The primary objects are to provide lubricating means for the main bearings in such a manner that as the main bearings or crank shaft of the motor is removed and replaced, an automatic positioning of the lubrication duct is had. A further object is to provide means for conveying the lubricant from the lubricating system.

Railways and Their Accessories

RAILROAD SPIKE—A. PLUMP, 420 Maple St., Redwood City, Cal. An object of this invention is to provide a spike, having means cooperating therewith to lock the spike in driven position against accidental withdrawal, and which is formed to cooperate with the tie plate to act on a key and driven into the tie in such manner that the portion of the key penetrating the tie will be deflected from a plane parallel to the longitudinal axis of the spike and thus hold the latter against accidental withdrawal or twisting.

SPARK ARRESTER FOR RAILROAD LOCOMOTIVES—F. H. CORDIS, Box 161, Thedford, Neb. The object of the invention is to provide a spark arrester which may be attached to the smoke stack of a locomotive in an easy manner, without interfering with the normal operation of the locomotive, and will thus prevent the sparks from starting a fire. A further object is to so construct the device that it may be easily swung from its operative position permitting a free passage in the smoke stack when so desired.

HOLDER FOR CAR REPLACERS.—W. H. SHUMAKER, 3030 N. E., 2d Court, Miami, Fla. An object is to provide a holder which is adapted to be applied to railway rails of any ordinary size and to car replacers of a plurality of types of construction and of different shapes and sizes, to effectively hold the replacer with which associated in a desired position in respect to a rail to prevent movement or distortion of the car replacer.

RAILWAY GATE ACTUATING APPARATUS.—F. G. BECK and W. D. SAUNDERS, 4924 Margarette Ave., St. Louis, Mo. The purpose of this invention is to provide a crossing gate actuating apparatus of simple construction which is operable by and upon the approach of a train or car to a railway crossing to close the gate, and to open the gate only after the train has traversed and is clear of the crossing. It is also a purpose to provide an apparatus with both audible and visible signals, automatically operated upon the raising of the gate, and means for checking the closing of the gate when a vehicle is in its path.

Pertaining to Recreation

GAME APPARATUS—J. O. EATON, 21 Crapo St., Taunton, Mass. Among the objects of the invention is to provide a simple but pleasing game wherein are provided means for supporting miniature values, as bowling pins, together with means for permitting easy projection of a ball against the pins, a vertically dropped ball being used either with a bowling alley, pool table or other device, and so arranged that a minimum space is required in simulating a full sized apparatus.

GAME—H. HAAS, 519 E. Washington St., Marengo, Ill. This invention has for its object to provide a game having pockets for holding prizes, and in which means are provided for causing the prizes to drop out when certain plays are made. A further object is to provide a game in which a ball is caused to descend an inclined board having pins on the surface thereof and arrive at one of a plurality of compartments at the bottom of the board, each compartment having a number which designates the score made in the play.

PUZZLE.—J. HYDE, 490 Fountain St., Providence, R. I. The invention relates to a toy or puzzle, and has for its general object to provide a puzzle comprising separable parts or bodies connected by novel means requiring particular manipulation thereof for the separation of the bodies. Two bodies are provided with connecting means in the form of a transverse rod, the puzzle being to separate the bodies.

SOUNDING DEVICE.—J. P. KEEGAN, 185 Christie St., Newark, N. J. This invention aims to provide a toy of the sounding type which may be readily and economically constructed, and in which the working parts will be reduced to a minimum, the construction being such that the device may be operated by a child without any danger or injury to the operator.

ANIMAL TOY.—S. B. KAHNWEILER, 393 Broadway, New York, N. Y. An object of the invention is to provide a toy for cats in the form of a stuffed mouse protected by a cage, the stuffing being of a material specially pleasing to the cat. A further object is to provide a toy in which a container of catnip is provided in a foraminous cage so formed as not to injure the cat as it tries to bite the same.

TOY.—R. P. SILVERTHORN, Box 122, Edison, Ohio. A specific object of this invention is to provide a toy parachute and a traveler adapted to be used in connection with an ordinary kite string for sending up and releasing the parachute. A further object is to provide a toy which will be amusing, efficient in operation and simple in construction. (See Fig. 10.)

Pertaining to Vehicles

LUGGAGE CARRIER ATTACHMENT FOR AUTOMOBILES—F. W. JACKSON and C. E. WILLSON, address R. D. Kiliman, 504 Sterling Trust Bldg., Saskatchewan, Canada. The object of the invention is to provide a device which may be easily attached to the running board of an automobile and adapted for folding upon the running board when not in use so that the same may not interfere with the opening and closing of the doors of the car with which it is associated.

HEADLIGHT.—A. C. WOODRUFF, Oakridge, Ore. An important object is to provide a dirigible headlight having simple means whereby the same may be caused to turn to correspond to the movement of the front wheels of a motor vehicle so that the rays of light are properly positioned with relation to the movement of the vehicle. A further object is to provide a headlight which may be applied to a vehicle without materially altering the construction of the same. (See Fig. 11.)

NON-SKID APPLIANCE.—M. W. STOUFFER, Box 99, Daytona, Fla. The foremost object of this invention is to provide a simple but effective device, applicable either to the pneumatic or solid type of motor vehicle tires, without in any way modifying or altering either the construction of the tire or the rim of the wheel. A further object is to provide an attachable tire armor, which can be put on or taken off, with the same facility as an ordinary non-skid chain.

PNEUMATIC SUSPENSION MEANS FOR VEHICLES.—J. O'CONNOR, 89 Audubon Ave., New York, N. Y. The general object of the invention is to provide a suspension spring for automobiles and other vehicles, in the form of a pneumatic tube, together with means to mount the spring on the frame of a vehicle, and means on the spring to mount the same on an axle.

AUTOMOBILE WHEEL LOCK.—L. E. TRIMM, 465 E. 29th St., Brooklyn, N. Y. An object is to provide a construction which is easily applied and removed, with means provided for the device to snugly fit the tire. A further object is to provide a lock in the nature of a chock which is so formed as to prevent any one from rotating the same after it has been applied.

SIGNAL.—G. F. MESSER, Box 56, Globe, Ariz. An object of the invention is to provide a signal which is adapted to be mounted upon an automobile and will serve to transmit intelligently to the operators of adjacent vehicles or other persons the direction, or rate of motion of the automobile, the signal is automatic in its action, and will be effective in night or day service.

PNEUMATIC TIRE.—B. J. MULLIKIN, c/o Brooks, Jamison & Prettyman, 211 No. 7th St., St. Louis, Mo. The object of the invention is to provide an overshoe wherein overheating of the same is prevented by dissipating the heat from the overshoe by the action of the same as it passes over the ground. Another object is to provide an overshoe which may be readily secured to a tire casing, and in which the side walls of the overshoe are thickened and made of live rubber to add strength to the tire at and directly above the rim of the wheel. (See Fig. 12.)

COOKER—B. B. DUDLEY, Visalia, Cal. The particular object of the invention is to provide a cooker to be used in connection with a motor vehicle, and constructed in such a manner that it receives its heat from the exhaust gases of the vehicle engine. A further object is to provide means for guiding the exhaust gases into the receptacle for heating the cooking vessels.

SIGNAL—F. GUENTHER, 329 Ellsworth Ave., San Mateo, Cal. Among the objects of the invention is to provide a signaling device which will indicate that the door of an automobile is open while the car is in motion, and will also show upon which side of the

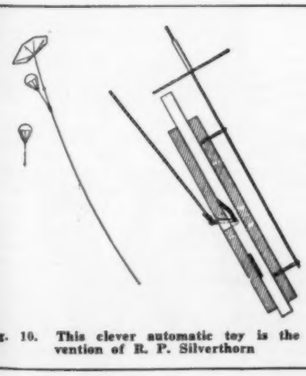


Fig. 10. This clever automatic toy is the invention of R. P. Silverthorn

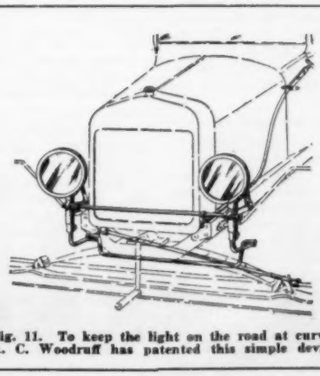


Fig. 11. To keep the light on the road at curves A. C. Woodruff has patented this simple device

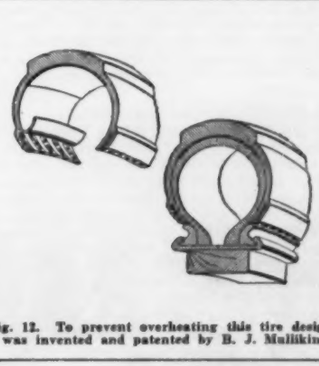


Fig. 12. To prevent overheating this tire design was invented and patented by B. J. Mullikin

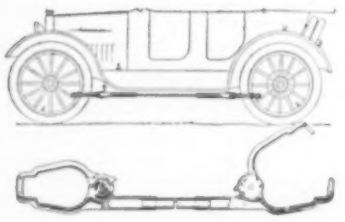


Fig. 13. To foil automobile thieves J. O. Davis has devised this attachment

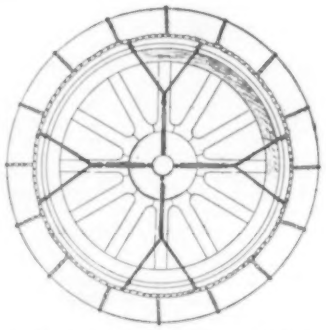


Fig. 14. An attractive new anti-skid chain tightener is the product of W. A. Stanley

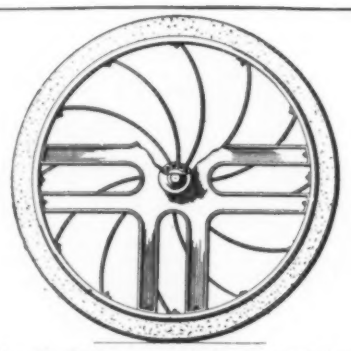


Fig. 15. To do away with the pneumatic tire this cleverly designed wheel has been patented by A. O. Benson, inventor

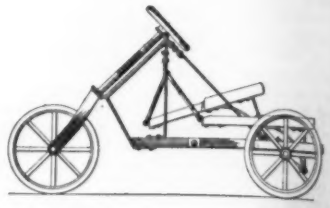


Fig. 16. This child's vehicle is the invention of C. M. McCormick

vehicle the open door is located, thus indicating to the operator the danger and possible damage to property, due to the fact that doors usually extend beyond the frame of the running board.

TANK FILLER—J. M. CARR, Belding Bldg., Stockton, Cal. This invention relates to valves especially adapted for application to fuel tanks of motor vehicles. An important object is to provide means whereby the suction or vacuum incident to the operation of internal combustion engines may be utilized to draw the fuel from a drum into the fuel tank of the vehicle. The valve is simple to apply and inexpensive to manufacture.

DETACHABLE CAMP KIT FOR MOTOR VEHICLES.—J. A. TRAIN, Wessington Springs, S. D. This invention relates particularly to a type of outfit arranged to be used in connection with an automobile, the object being the provision of an arrangement which may be clamped to the running board of car in such a way as to provide for cooking and the support of cooking and eating utensils as well as to form a luggage holder when necessary.

THEFT-PREVENTING DEVICE FOR AUTOMOBILES.—J. O. DAVIS, c/o F. J. Cheetham, Atty., Taos, N. M. This invention relates to a device for locking together the front and rear wheels of an automobile and thus rendering the vehicle inoperable. The device comprises a pair of jaws and locking means and telescopic pipe sections connecting the jaws. The jaws may be moved toward each other thus shortening the length of the device for storage. (See Fig. 13.)

BOLSTER—J. DYER, 5560 Ardmore Ave., Chicago, Ill. This invention relates particularly to bolsters in vehicles. An object is to provide a device adapted to be used in transporting a load such as lumber or the like from place to place with the necessity of handling the pieces composing the load at each operation obviated. A further object is to provide a device whereby the maximum number of loads may be transported in a given time.

POWER LOADING AND UNLOADING DEVICE—J. DYER, 5560 Ardmore Ave., Chicago, Ill. An object of this invention is to provide a loading and unloading device that can be readily attached to a motor vehicle, and can be driven by power supplied by the engine or motor of the vehicle. A further object is to provide a device that is simple and durable, and can be easily operated by one person.

TIRE DISPLAY FIXTURE.—R. L. CHRISTY, Lamar, Colo. An object of the invention is to provide a tire display fixture which is adapted to support and to rigidly hold a tire of any size. A further object is to provide a device which is adapted to display both sides and the tread of the tire, and to support show cards or articles, such as inner tubes within the center of the tire.

COMBINED CUPBOARD AND FOLDING TABLE.—W. H. HARRIS, 575½ East Burnside St., Portland, Ore. This invention relates to a device to be carried on the running board of an automobile, an object is to provide a cupboard of ample size to store lunch dishes, cooking utensils and necessary supplies for camping parties, provision being made for holding folding camp stools, and to provide a folding table that will be rigid and may be quickly set up, the whole being dust proof when folded for travel.

DIFFERENTIAL.—C. C. CRISPEN, 708 N. 17th St., Harrisburg, Pa. An object of the invention is to provide means whereby a differential associated with the driving axle of a motor vehicle may be caused to operate for driving one wheel at twice the speed it would be driven when the differential is operating normally, and at the same time disconnect the other wheel from the differential so that it may freely revolve, and means being operable from the driving seat of the vehicle.

AUTOMOBILE SHADE.—R. DONER, 1538 East 64th St., Chicago, Ill. Among the objects of this invention is to provide an automobile shade for use on wind-shields which can be instantly moved to any part of the shield so as to intercept the sun's rays that would ordinarily strike the driver's eyes. A further object is to provide a shade which can be pulled down to any desired length and tilted or swung so as to be parallel with the plane of the wind-shield.

MULTIPLE DISK BRAKE.—V. W. PAGE, c/o Victor Page Motor Corp., Melrose Ave., Stamford, Conn. The invention pertains particularly to brakes for motor vehicles. One of the objects is to provide a brake which is adapted to exert a braking action upon the driving mechanism of a vehicle. A further object is to construct a brake of a plurality of plates adapted to be moved into engagement with one another to provide the necessary friction for braking action, and to provide a brake which will be compact, and may be positioned on the power shaft between the transmission and the universal joint.

WHEEL FOR AUTOMOBILES.—H. M. HOWELL, Box 442, Monroe, La. The object of the invention is to provide a demountable rim which may be readily and easily assembled with or disassembled from the wheel, in which the demountable rim permits of the removal or replacement of a tire without the necessity of pinching the tire over the retaining flange, and in which the demountable rim is securely locked and effectively supported in assembled position on the wheel.

BRAKE-TESTING MACHINE.—R. B. SPIKES, c/o Automatic Car Appliance Co., Fort Bragg, Calif. The object of the invention is to provide a brake testing machine for use in conjunction with motor vehicles, which provides for the testing of the efficiency or of the power of the brake and makes and records the results of the test, and which is of simple and durable construction, reliable in operation, and adapted to be manipulated by a single operation.

SELF-LOADING MECHANISM FOR VEHICLES.—J. B. VON CANON, West End, N. C. The purpose of the invention is to provide loading mechanism which includes endless chains of constantly moving buckets adapted to be automatically actuated to successively occupy scooping, loading and dumping positions at proper intervals to scoop the material from a point beneath the vehicle and to convey such material to and above the vehicle body where it is dumped into the body.

BELT-TENSION ADJUSTER.—L. N. and G. E. WYATT, 1625 Gray Ave., Detroit, Mich. The invention relates to an adjuster for use in connection with a fan belt of an automobile. The principal object is that the belt tension adjuster shall be automatic in operation and at all times maintain the belt under constant tension. A further object is to make the device simple in construction and positive in operation.

SAFETY DEVICE FOR THE CLUTCH-CONTROLLING MEANS OF AUTOMOBILES.—J. CALCATERRA, c/o C. C. & F. Mfg. Co., 120 E. 32d St., New York, N. Y. The general object of the invention is to provide a safety device for preventing an automobile from accidentally creeping forward or running away, the device being subject to the control of the lever and controller shaft, and yet adapted to be manually controlled.

TRACTION WHEEL.—A. J. HARDER, 622 First St., West Watertown, S. D. Among the objects of this invention is to provide a form of traction wheel of open construction that will not become clogged when used on soft ground and which has a circular bearing surface that makes the machine ride smoothly on hard ground. Narrow wheels of this construction may be employed where two wheels instead of one are required.

AUTOMOBILE WORKSTAND.—W. P. KRAMER, R. F. D. No. 2, Saginaw, Mich. An object of the invention is to provide a stand in which a car may be placed and the stand moved to turn the car on its side or into any convenient position for the purpose of repairs. A further object is to provide a stand which is strong and efficient in use, with simple and practical operating means.

LEVER LOCK.—D. M. HINRICHS and A. T. MILES, c/o D. M. Hinrichs, Genl. Exchange Corp., 224 W. 57th St., New York, N. Y. The primary object of the invention is to provide a lever lock intended for use in connection with the gear shift levers of a motor driven vehicle, although not necessarily limited to this adaptation. The invention aims to provide a lock by means of which the lever will be locked in such a manner as to practically preclude any danger of an unauthorized person effecting a subsequent movement of the same.

CONVERTIBLE AUTOMOBILE BODY. F. A. SCHNUPP, R. F. D. No. 6, Mechanicsburg, Pa. The object of this invention is to provide a body which may be converted from a truck into a limousine or vice versa in very little time. To accomplish this in the forming of a truck, gratings are provided for each side of the body, the rear end consists of a pair of doors, formed to correspond with the outlines of the limousine, and the rear seat and its associate parts are removed.

AUTOMOBILE SHADE. — R. DONER, 1538 East 64th St., Chicago, Ill. An object is to provide a curtain shade of two loose plies and a supporting frame between the plies, and a catch by means of which the curtain may be locked in its rolled position. A further object is to provide a device in which the curtain may be easily removed and exchanged for a new curtain. The complete device giving a neat appearance.

SHOCK ABSORBER.—P. DU FORD, Ontario, Ore. One of the principal objects of the invention is the provision of a simple inexpensive and efficient shock absorber which may be readily associated with any standard vehicle, without the necessity of materially altering the same. The device is particularly designed and intended for use in connection with the front or rear springs of a motor vehicle.

MACHINE FOR BUILDING CYLINDRICAL TIRE BLANKS.—B. DE MATTIA, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, New York, N. Y. An object of this invention is to produce a machine whereby a cylindrical tire blank comprising a plurality of superimposed layers of rubber coated fabric may be quickly produced, and whereby the bead in the edge of the blank may be quickly formed in what will be practically a jointless bead construction, and whereby also the tread strip may be readily applied to the outer surface of the superimposed layers of fabric and by a more or less automatically operating mechanism to produce simultaneously a plurality of cylindrical tire blanks.

TIGHTENER FOR ANTISKID CHAINS.—W. A. STANLEY, W. 3701 Green Ave., Spokane, Wash. An object of the invention is to provide a simple and effective device which is light in weight and adapted to be applied readily to an anti-skid chain mounted upon the pneumatic tire of an automobile wheel of ordinary construction. A further object is to provide a tightener having means for exerting balanced tensions at a plurality of spaced-apart points. (See Fig. 14.)

AUTOMOBILE SIGNAL. — E. W. COURTRIGHT, 311 E. 84th St., New York, N. Y. Among the objects of this invention is to provide a signal in the form of a semaphore which may be mounted upon the mud guard or any other conspicuous place about a car to warn drivers of approaching cars or following cars the proposed movement of the car carrying the signal. A further object is to provide a form of pedal controlled operating means therefor.

WHEEL—A. O. BENSON, 1641 W. 55th St., Los Angeles, Cal. An important object of this invention is to provide a vehicle wheel having a high degree of resiliency so that the necessity of employing pneumatic tires is overcome. A further object is to provide means associated with the wheel to limit the spring action and to limit the side thrust, the means also constitutes a bracing element for the spokes of the wheel. The wheel is simple, neat in appearance and inexpensive to manufacture. (See Fig. 15.)

VEHICLE WHEEL.—H. D. REY, Avarua, Barotonga, Cooks Islands. An important object of the invention is to provide a vehicle wheel having means whereby the felly may be extended after the tire rim has been applied so as to securely hold it in position. A further object is to provide a split felly and means whereby the ends of the felly may be arranged in spaced relation to receive the stem or nipple of the tire valve in such manner that the valve will not be sheared off as a result of movement of the tire.

CHILD'S VEHICLE—C. M. MCCORMICK, 1229 E. 6th St., Pueblo, Cal. An object of the invention is to provide a vehicle which is adapted to be propelled by the user in such manner as to bring about not only individual development of the various muscles but also coordinate between them and to develop the sense of equilibrium of the user and his ability to maintain his balance and which in general affords a healthy form of outdoor exercise and amusement. (See Fig. 16.)

Designs

DESIGN FOR A TEXTILE FABRIC.—C. E. LORD, c/o Galey & Lord, 25 Madison Ave., New York, N. Y. The inventor has been granted patents on four ornamental designs for textile fabrics.

DESIGN FOR A LIGHTING FIXTURE.—A. MILLER, 2091 Prospect Ave., Bronx, N. Y. This inventor has been granted three patents on ornamental designs for lighting fixture arms and loops.

DESIGN FOR A TEXTILE FABRIC—C. E. LORD, c/o Galey & Lord, 25 Madison Ave., New York, N. Y. The inventor has been granted patents on two ornamental designs for textile fabric.

DESIGN FOR A FINGER RING, BADGE, BUTTON OR ARTICLE OF SIMILAR NATURE—J. W. ELLIOTT, c/o Chas. F. Murphy, 141 Broadway, New York, N. Y.

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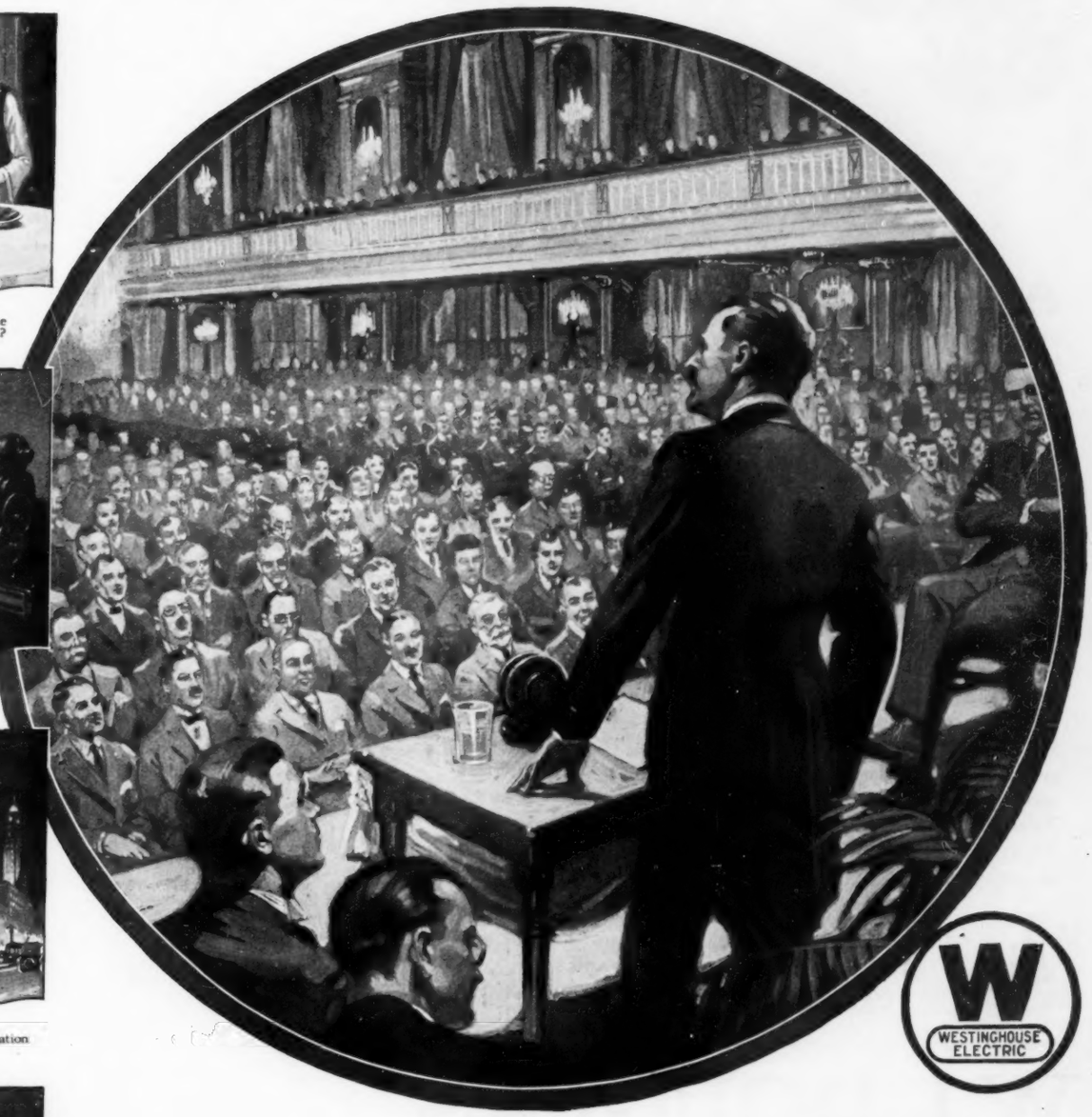

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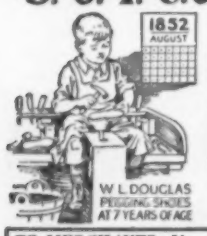

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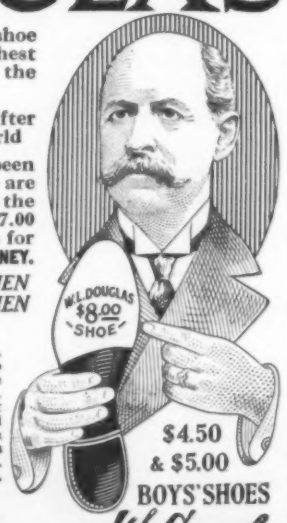

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Correspondence

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The Economics of Farming

To the Editor of the SCIENTIFIC AMERICAN:

The average term of years spent on the farm is shortening because when the average farmer reaches the age where he can no longer do his work with his own hands he must give up farming, no matter what his experience; a shortage of skilled and unskilled labor is responsible for this condition. Unskilled labor prefers a precarious living and ownership to good wages under a boss.

During the war, and for a time after the war, many inexperienced people came from the cities and purchased farms, giving, in most cases, much more than the farms were worth; usually they paid their savings, accumulated from the high wages prevailing at that time, as a first payment and gave a mortgage for the balance.

Production has fallen by half on all farms purchased by novices, and the purchasers have remained only by abandonment of the scale of living usually found in the country.

The blame for this condition of affairs lies at the doors of the editors of the yellow newspapers and magazines who, in order to stir up feeling between city and country, wrote editorials pointing to the farmers as profiteers of great wealth. They struck at the farmer and hit their subscribers and readers.

Half of these purchasers of country real estate will return to the cities within two or three years. Many will lose their entire investment.

Jefferson, N. Y. ROSCOE C. JONES.

Soaring Flight

To the Editor of the SCIENTIFIC AMERICAN:

In a recent number of the SCIENTIFIC AMERICAN, a very interesting description is given on the great progress made by the Germans in the operation of soaring planes, that is, planes capable of flying without motor. It is regrettable, however, that no mention is made in this article of the originator of soaring flight, Professor Langley. Professor Langley not only was the first who built an operative power driven airplane, but also investigated, solved and published the principle of soaring flight, in his article on the "Internal Energy of the Wind," long before an operative airplane was built, I believe even before the work of Lilienthal with gliding machines.

I do not have Langley's article here, thus must go by memory, but you can undoubtedly hunt it up. Langley devised, designed and built an anemometer, that is, wind measuring instrument, of so little momentum that it instantly followed any variation of the wind velocity, and with this he found that the velocity of the wind is practically never constant or even approximately constant but almost always varies greatly and very rapidly, being "gusty." He further showed that these rapid variations of wind velocity constitute a continuous source of energy, which may be used to raise a plane and propel it, and that the soaring birds utilize this source of energy.

If in a stationary airplane the wings are tilted up against the wind, the wind exerts a lifting force on it, but also carries it back, in the direction of the wind. This lifting force persists until the plane has reached the same speed as the wind, and then stops, and a steady wind, while it may lift a plane off the ground, cannot permanently support it. If, however, when the plane has assumed the same speed as the wind, the wind stops or decreases, that is, the plane passes from a gust into a quieter region of the air, then there is again a difference of speed between the plane and the air in which it floats, and this difference of speed can by properly tilting the plane, be used to raise it. In other words, in gusty air, by maneuvering the plane so that it always, or most of the time, has a difference of speed against the surrounding air, a force can be maintained on the plane, and the rise given by it utilized to support the plane during the interval when its speed does not differ from that of the air.

The effect on the air, is that the faster moving air, in the gust, is slowed down, the slower moving air between the gusts is speeded up, and the wind velocity thereby equalized. The faster moving air, in slowing down, gives off more energy than the slower moving air takes up in speeding up, because the energy varies with the square of the velocity, and the difference is the energy available for soaring, the "internal energy of the wind," as Professor Langley called it.

Suppose the wind fluctuates between velocities v and w, and its total energy therefore between $\frac{1}{2}mv^2$ and $\frac{1}{2}mw^2$. After equalizing their velocity to the average $\frac{1}{2}(v+w)$, the energy of the two masses $\frac{m}{2}$ of air, of velocities v and w, is $2 \times \frac{1}{2}m \times [\frac{1}{2}(v+w)]^2$, or, more simply $\frac{m}{4}(v+w)^2$.

The wind has thus given off the energy

$$\frac{m}{2}(v^2+w^2) - \frac{m}{4}(v+w)^2$$

$$= \frac{2m}{4}(v^2+w^2) - \frac{m}{4}(v^2+2vw+w^2)$$

$$= \frac{m}{4}(v^2-2vw+w^2) = m\left[\frac{v-w}{2}\right]^2$$

The available energy, or the *internal energy of the wind*, thus is

$$\frac{m}{2}\left[\frac{v-w}{2}\right]^2$$

where m is the mass of the air, and its velocity fluctuates between v and w.

Assuming the wind velocity to fluctuate between 60 and 20 kilometers per hour, or 16.8 to 5.6 meters per second, and the mass per cubic meters of air as 0.12 kilograms; the internal energy of a cubic meter of air then is 1.89 kilogram-meters, or 1/40 horsepower-second.

Assuming then that the soaring plane could utilize this energy, it would require 80 cubic meters of air to impinge against the plane per second. With an average relative velocity of the plane against the air, of 20 kilometers per hour or 5.6 meters per second, a projected wing surface of 14.3 square meters would be required per horsepower, giving a thrust of 0.94 kilogram per square meter projected wing surface, that is, a little less than one kilogram per square meter.

While this estimate is very crude, only, it shows that quite considerable lifting forces may be expected from the "internal energy of the wind."

In view of the present interest in soaring machines, therefore, I believe it would be desirable to bring Professor Langley's pioneer work on the soaring flight and the internal energy of the wind, to the attention of the public.

CHARLES P. STEINMETZ.
Schenectady, N. Y.

Telepathy and Survival

To the Editor of the SCIENTIFIC AMERICAN:

From your article, "Our Psychic Investigation" in the February issue of the SCIENTIFIC AMERICAN, page 84, I quote the following:

"The unhappy fact is, indeed, that both explanations (individual survival and telepathy) explain so completely and in such detail that it seems to be an utter impossibility to discriminate between them by piling up a multitude of observations upon direct messages. So far as I can see, no message susceptible of verification could ever be received which could not with equal completeness be accounted for on both grounds."

My knowledge of spiritualistic evidence, whether of "direct messages" or otherwise is practically nil. But from the face value of this quotation the conclusion would seem to follow that since the evidence produced exactly fits both the theory of individual survival and that of telepathy, that both these theories are correct.

Science seems to have taken it for granted that these two hypotheses are contradictory; but are they?

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Testing the question by the contents of your article, science seems here to have made a catch judgment. Prima facie it does not follow that because telepathy is present during bodily existence that it need be restricted to bodily existence.

In fact telepathy has an occult appearance that particularly fits it for a connecting link between life before and after the grave. It seems to me that if spiritualists are to persist in the theory of life after death, they must necessarily establish some such connecting link on which the continuity of life can be predicated.

Our personalities are built partly of hereditary qualities and partly from personal reactions to environment. Survival of these personalities, so far as I can judge, is the meaning of personal survival. If these personalities are to persist after the disintegration of the body, they must do so because of characteristics possessed before that disintegration. Such continuity is the very meaning of survival.

Telepathy fits the facts claimed to be recorded from both sides of death; it apparently transcends the time and space restrictions of our body; it is a substantiated scientific fact, and therefore would seem to be a suitable ground on which to build the theory of individual survival.

I admit my ignorance of both telepathy and spiritualism and so this conclusion is open to all sorts of objections. Still it does seem to follow logically from the face of your article and especially that portion of it quoted above.

WILLIS A. KINGSBURY, JR.

Holliston, Mass.

Wanted: An Overload Safety Device for Automobiles

To the Editor of the SCIENTIFIC AMERICAN:

It is getting to be quite a common occurrence, especially at the end of a sunny Sunday's run, to see at the side of the road a good many motor cars laid up with broken axles or stripped gears in transmission or differential. Such mishaps take place generally when the full power of the motor is suddenly applied to the driving wheels through the lowest gears, when the machine happens to be in a difficult driving position, such as deep sand, or when a motorist carelessly starts his machine with the emergency brake firmly set on.

The combination of a powerful low gear, a velvet clutch and a wide open husky motor offers at times a tremendous strain somewhere between the flywheel and the rear hubs and when the critical limit of resistance is reached some part, the weakest, is bound to give away. A broken axle or a sheared key is usually the result. Almost invariably some gears in the transmission will be stripped when the car is coasting in one direction and the change gear lever is wrongly engaged in the opposite direction.

These serious breakdowns could be almost entirely eliminated if a safety device, or rather a safety coupling, could be inserted somewhere in the driving mechanism for its protection against sudden and destructive overloads, just like a fuse or circuit breaker is placed in an electrical circuit to protect the electrical equipment and buildings. For obvious reasons, that coupling should be very easily attached or detached, the removal of not over four bolts being necessary. Also a supply of three or four extra couplings should always be carried along in the car for emergencies.

These safety couplings should be so calibrated in strength as to give ample protection to the driving parts and yet be resistant enough to handle every case of moderately severe application of power. When a safety coupling gives away, the motorist should, of course, immediately realize that the driving mechanism is being strained, and that before starting on a fresh coupling, he should "ease 'er up a bit," according to the circumstances, that is, dig around some, if stuck in the sand, or remove part of the load if climbing a steep hill.

A logical location for the safety coupling would be just back of the transmission case, because it is the most accessible place on most cars and trucks. Perhaps a combination safety coupling and universal joint could be made into one member and thus serve a double purpose. The material most likely suitable for the coupling is leather or some special rubber composition.

No doubt this idea of safety coupling is a very useful one and the first car equipped with such a device will not fail to attract due attention.

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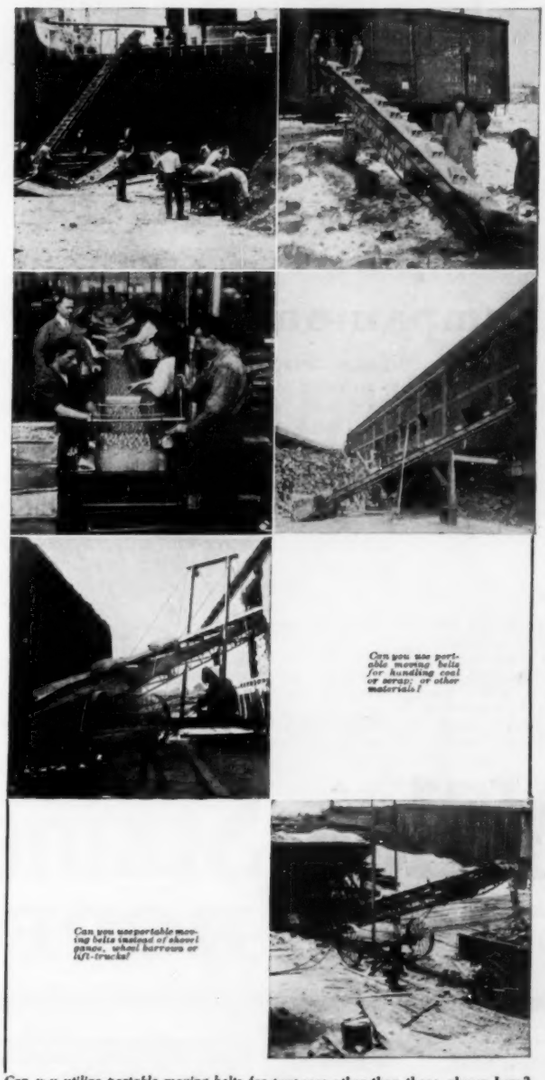
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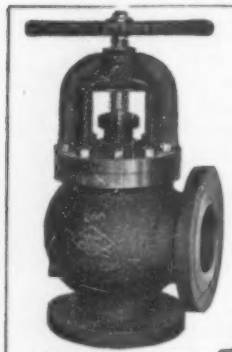

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Miscellaneous Notes

English Books in 1922.—During the year 1922 a total of 10,842 books were published in the United Kingdom. Books on technology fell off materially.

An Exhibition for Doctors Only.—An exhibition was recently held in London for the twelfth time for doctors only. The public is strictly excluded but an attendance of several thousand doctors justified the enterprise.

End of a Cable Ship.—The "Faraday," one of the most interesting ships afloat, has just been retired as a cable layer after 48 years of active service in laying submarine cables in all the seven seas. She is not to go to the ship breaker, but will become a tanker.

Rock from Mount Everest for the Papal Collection.—The members of the recent Mount Everest expedition have sent to Pope Pius a fragment of rock from the highest point reached. The fragment is mounted on an ebony stand, decorated with silver, with an engraved inscription. The Pope, himself an Alpinist, greatly appreciates the gift, and has sent to General Bruce, leader of the expedition, the gold medal of his pontificate with an autograph letter of thanks.

Oldest Frame Building.—What is said to be the oldest frame building in the United States is the old Quaker meeting house at Easton, Md. Local histories place its date of erection in 1684, giving the ancient structure an age of 239 years, and it is said that William Penn attended service in the meeting house while he was trading with the Indians. The only preservative used on the wood has been old-fashioned whitewash on the outside. Seven of the original plank seats and the woodwork inside have had no paint whatever.

Match Factories in China.—A steady decline in China's purchases of Japanese matches has been noticeable since 1912, imports falling from 436,844 cases in that year to 152,543 cases in 1920 and 105,479 cases in 1921. This decrease was mainly due to the increased production of matches in China. In 1921 Manchuria had nine factories, North China eleven, Central China thirty-one and South China thirteen. With a steady growth in the consumption of cigarettes and with the gradual industrialization of China, that country should be a fertile field for match factories. All of the raw materials are at hand, the match wood coming from Manchurian forests.

"The Ordeal of Water."—France occasionally harks back to the Middle Ages, as recently when a justice of an inferior court allowed the old "Ordeal of Water" to decide a case. It appears that the case was that of a dye company against which charges were brought by the Prefect of the Department with a society of fishermen joining action to prevent the company emptying coloring matters into public streams. They received 5000 francs for damages done to fishing. Counsel for the defense, in summing up declared the water near the mouth of the company's drain was not harmful to fish and asked to make a demonstration. "If the fish die it will be a sort of judgment of God renewed from the Middle Ages, and we will have lost our case," he stated. A bucket of healthy fish was then presented to the judge, who placed them in a bowl of alleged contaminated water. In less than two hours all the fish had died.

Wood Used in Mount Vernon.—A trip was made to Mount Vernon, Va., by W. D. Brush, one of the experts of the United States Forest Service, to determine the kinds of wood entering into the construction of Mount Vernon mansion. With the exception of several joists under the first floor and the sills which formerly rested on the ground and have since been entirely replaced by brickwork, the timbers are the original ones placed in the house in the period between 1743 and 1744, and are in an excellent state of preservation. Those in the basement are very dark in color, and the surface of the wood has a flaky or crumbly appearance, but seems perfectly sound in the interior. All of the framing timbers seen are evidently red oak, and the large timbers are fastened together by wooden pins. Records show that these red oak timbers were secured on the place, and letters which passed between George Washington and the builders also show that an attempt was made to obtain white oak, as its superiority over red oak was appreciated at that time.

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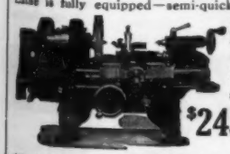

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Hudson's Bay, the "Neglected Sea"

(*Continued from page 365*)

free from reefs or shoals. In thick weather or snow storms the danger of running ashore is very considerable. Still, there is now a remedy for this which did not exist 12 years ago—directional radio.

Next to strictly navigational problems the greatest difficulty presented to officers of the Hudson's Bay Company's ships in the past has been the ice. In this there has, of course, been no change. But taking an average summer: we arrived at Cape Chidley (the entrance to Hudson Strait) on the 22nd of August. The natives there told us that the whole strait had been choked with ice only a fortnight before. Yet when we looked westward from the crow's nest hardly a pan of ice could be seen.

We found this condition held good for the whole length of the strait, and in the bay there was, if possible, even less ice. Some summers the ice goes out earlier than others; but nearly always it does go out, as if by magic, almost overnight. A radio station at Cape Chidley maintaining contact with the series of stations already established on the coast of Labrador could keep the shipping world in touch with ice conditions in Hudson Strait just as is done today for Belle Isle Strait and other northern waters all over the earth. Indeed, it is the opinion of competent navigators who have testified before the Canadian Parliament that during the three or four months of open navigation, before the winter freeze-up begins, this route may be traversed by an ordinary tramp steamer more safely than the Gulf and River of St. Lawrence to Montreal.

Some sheathing of the ship's forward waterline would be desirable to guard against damage from small pans of ice, but there would be no need for specially constructed ice breakers unless it was contemplated to delay the closing season past November. A seasonal lighthouse would be essential at Cape Chidley and another at Cape Wolstenholme, the corner where strait and bay meet. Two other points where lights might be desirable are Big Island (on the Baffin Land side) and the east point of Salisbury Island—but that is a matter of detail. The important thing is that Hudson's Bay and Strait are easily navigable by properly equipped vessels during a limited season, and that the route can be safeguarded at no great expense.

An interesting sidelight on the whole problem is the fact that contemporaneously with the establishment of an over-seas route a very important local trade might be built up. The South Belcher Islands have been re-discovered after having been lost to knowledge in the southeastern corner of the bay during many years. These islands, of some 10,000 square miles area, are reported to contain extremely valuable commercial ore deposits. If this proves to be the case, the development of this wealth will demand cheap transportation across the bay and the tundra land back of it.

Your Automobile and the Thief

(*Continued from page 367*)

business and they always go informed.

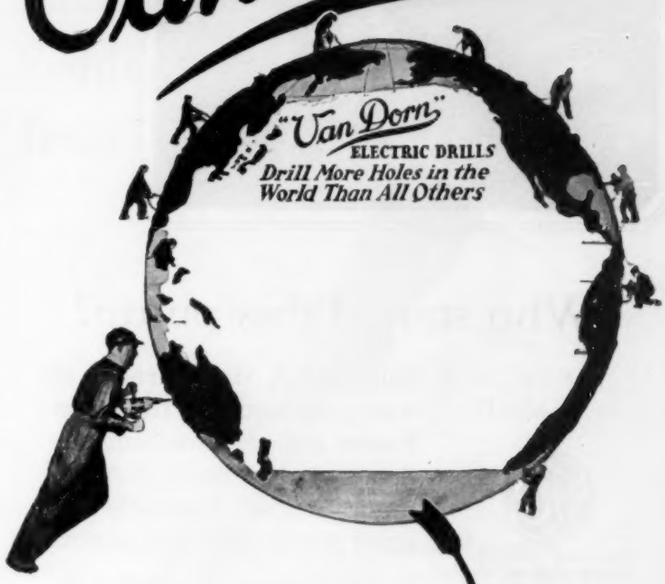
But the extent to which locked cars figure in automobile stealing is so small as to strike wonder into the minds of those not well acquainted with the facts. More than 75 per cent of all stolen cars are not locked. The thief has nothing to contend with and he knows this when he acts. The negligence of owners is, of course, responsible, but the methods used by motor thieves need also to be considered.

The public believes that the motor thief generally lies in wait at some point of vantage for cars left at the curb and then appropriates, on the spur of the moment, the most available vehicle. It is true that this is what sometimes happens. But in the great majority of cases the thief when he acts is better informed. He has usually studied the owner for some days, weeks or months before he commits his crime. He knows who owns the car, where he lives, what are his weaknesses. As soon as he discovers that the owner is in the habit of entering a certain building at a given hour of the day or night, leaving his car unlocked at the curb, the thief lays out all the details of his plan and acts only when they are complete. These arrangements are usually much more elaborate than outsiders suppose.

If we remember that a successful job of automobile stealing involves not only the original theft of the car but its initial concealment, proper protection for the thief afterwards, alteration of the numbers and changes in the appearance of car, careful

(*Continued on page 424*)

"Van Dorn"



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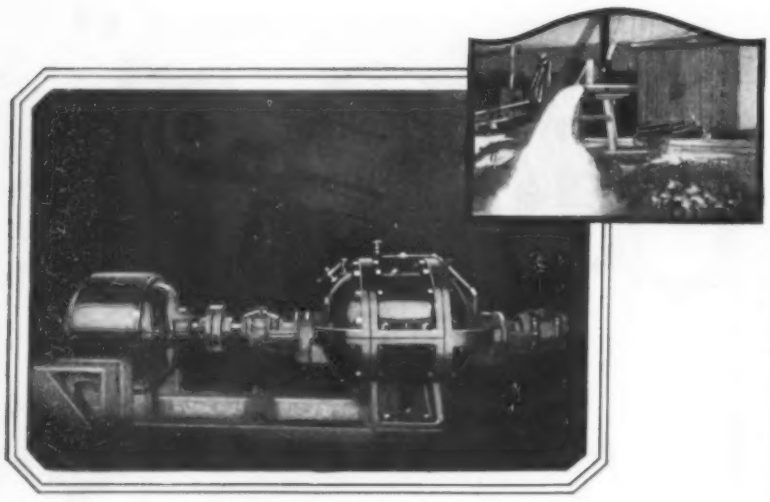

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Civil Engineering Notes

Noiseless Trolleys equipped with roller bearings are to be installed in St. Paul and Minneapolis. A saving of 12 to 15 per cent in power as well as better control of the car is expected.

French Railway Tunnels.—Two tunnels are to be driven through Mont Blanc having a length of about nine miles. Four more tunnels will be run under the Vosges, connecting the French and the Alsatian railways to be connected.

A Decrease of 2200 Miles in the length of railroad lines in the United States between 1916 and 1921 is accounted for by too much government regulation by *Railway Age*. This shrinkage contrasts with a gain from 1910 to 1915 of 20,000 miles.

The World's Production of Tin has fallen off until in 1921 it was the lowest annual output since 1908. The United States consumes about one-third of this production but in 1921 produced only four tons of tin. The chief producers are the British Empire and the Netherlands East Indies.

The Cost of Transporting Materials by different means is compared in the *Journal* of the Society of Automotive Engineers. It is stated that one dollar will haul a ton of freight nine miles by horse and wagon, 24 miles by motor truck, 185 miles by railroad, 230 miles by canal and 3000 miles by ship.

Standardized Engineering Symbols is the goal of a committee known as the American Engineering Standardization Committee. The *Iron Age* states that it is believed that such a result would do away with the present confusion, misunderstanding and frequent errors due to the present condition of the subject.

A 600-Foot Concrete Tower is soon to be erected at Wembley, near London, at the seat of the British Empire Exhibition for the purpose of giving visitors to the exhibition a view of the surrounding country. It will have a searchlight powerful enough to be seen from the coast of France. A large cage will make the trip to the top of the tower spirally and at the rate of 14 miles per hour. It is believed that the lights of Birmingham, 115 miles distant, will be visible from the top of the tower.

An Automatic Furnace for hardening rock drills has been perfected by an engineer of the Rand mines. This invention works on the principle that steel becomes demagnetized at a certain temperature and is no longer subject to the pull of a magnet. The steel, when it reaches the required temperature, is automatically pulled from the furnace, ringing a bell as it withdraws in order to warn the tool dresser that it is ready for hardening. Uniform results are obtained at the comparatively high rate of 150 to 200 drills per hour.

Diesel-Engined Locomotives. — Representatives of the Russian government in Berlin have contracted for the construction in Germany of a number of Diesel-engined locomotives, according to *Railway and Locomotive Engineering*, which adds that the new locomotives will cost about twice as much as steam locomotives. But this is counterbalanced by their ability to do without water in a part of that country where it is somewhat scarce. This feature will permit the extension of railways into sections of Russia where they are now nonexistent. Part of the new locomotives will have electric drive, and the remainder will have hydraulic transmission.

Rough Switching of Cars is being combatted by the Illinois Central by means of motion pictures showing the damage thereby brought about as actually taking place in special cars having one side removed in order to expose the contents. These cars are loaded with ordinary merchandise and are bumped by the locomotive at various speeds from one to twenty miles per hour. The pictures show, according to *Railway Age*, that collisions at a speed of 12 miles per hour result in the nearly total destruction of ordinary freight. Switchmen are thereby taught graphically the effect of rough handling of freight trains and cars in the yards. Moreover, the same films will be used to educate the public in the matter of more careful preparation of merchandise for shipment. Similar experiments might be made with passenger coaches loaded with human beings in an effort to bring about the careful accelerations of trains felt on European railways.

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(2234)

Mechanical Engineering Notes

Standardization of Manufacturing Processes under the efforts of the Fabricated Production Department of the Chamber of Commerce of the United States has been largely brought about in the bicycle industry, 22 models having been dropped up to the present time, and many parts have been standardized, including threads and taps.

Industrial Growth in the United States has taken place to the extent of 5600 per cent since 1849. The dollar value of manufactured products at that time was 1091 millions, while in 1919 it was 62,418 millions. But power use has outstripped the increase in the number of wage earners, advancing from 2,350,000 horsepower in '69 to 30,000,000 horsepower in '19.

The Piano and the Engineer.—The supporting structure for the strings of a piano involves a very careful engineering design in order that it may withstand the tension of the strings, providing perfect stability under all temperature conditions so that the piano will not get out of tune. The total tension of all these strings in a standard piano is between 35,000 and 50,000 pounds. These strings must all be attached to a frame within a width of 60 inches.

Small Templets, which are ordinarily made from sheet metals, may be very quickly made from celluloid. A writer in *American Machinist* states that celluloid taken from old automobile curtains which are brittle, is the proper material as it breaks easily along the scribed line, thus doing away with all filing. The transparency of the celluloid is an added advantage, especially when making a templet from a drawing, as in this case the entire drawing can be seen.

Testing Brass Pipe.—One of the most interesting checks on the temper and chemical characteristics of brass pipe is the ability of the chemist to look inside the metal with the aid of a microscope and see the grain structure of the brass itself. To the experienced eye of the brass chemist, the formation, size and color of the grain will tell many things about the metal. They will show the temper of the brass, and it is many times possible to detect dangerous stresses which leave a pipe liable to season cracks. The manufacture of brass pipe has made great progress since the old days when the metal was cast by the "I hope so" rather than the "I know why" process. Brass making is a scientific business and brass pipe is now produced constant in alloy, standard in temper, with dangerous stresses removed by scientific heat treatments.

The Contour Projector.—Imperfections in gears and the causes for such imperfections can be accurately determined by the use of a contour measuring projector, by throwing on a screen the image, greatly enlarged, of the gear in profile. The slightest deviation from the true curvature can be readily determined by comparison with a master outline. When gears are meshed and set to correct center distance, errors of eccentricity, uneven spacing and lack of proper rolling action can be plainly observed. Very accurate measurements of thickness of tooth at the pitchline can be obtained from the enlarged profile, while records can be secured by photographing. This implement can be used for checking gages, cutting tools, screw threads and the like, as well as for inspecting the contour of all small parts.

Desulfurization of Coke by Steam.—In the course of laboratory experiments in the desulfurization of coke by steam, being conducted by the Department of the Interior, at the Pittsburgh experiment station of the Bureau of Mines, steam tests at atmospheric pressure for the removal of sulfur from chunk size coke have been finished. Combined sulfur as FeS, $FeSO_4$ and free sulfur (not including solid solution sulfur) in Ohio coke was reduced from 1.38 to 0.72 per cent, according to *The Iron Age*. The solid solution sulfur was not affected, but it has been shown that this has very little effect in contaminating sponge iron in the blast furnace. In Illinois coke 0.62 per cent sulfur corresponding was reduced to 0.48. Clairton coke low in sulfur was reduced from 0.29 to 0.17 per cent. Sulfur in a sample of gas-house coke from Philadelphia was reduced from 0.81 per cent to 0.60. These results were obtained without application of vacuum, which may reduce still further the amount of sulfur. Very little steam is required.

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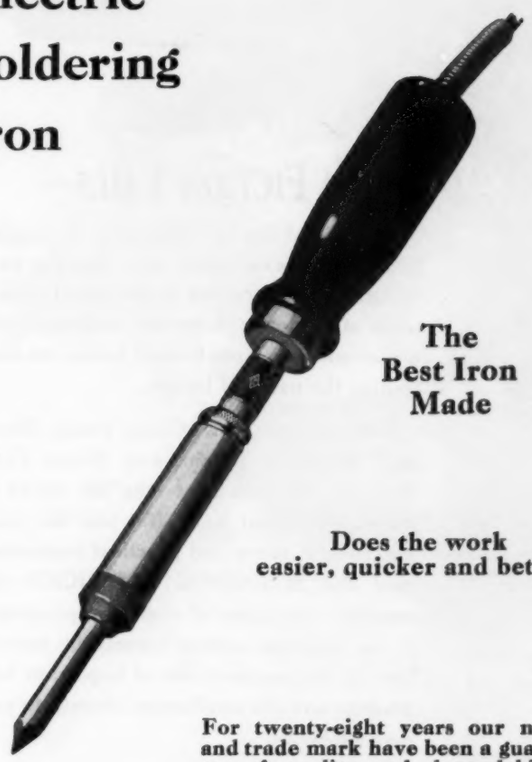

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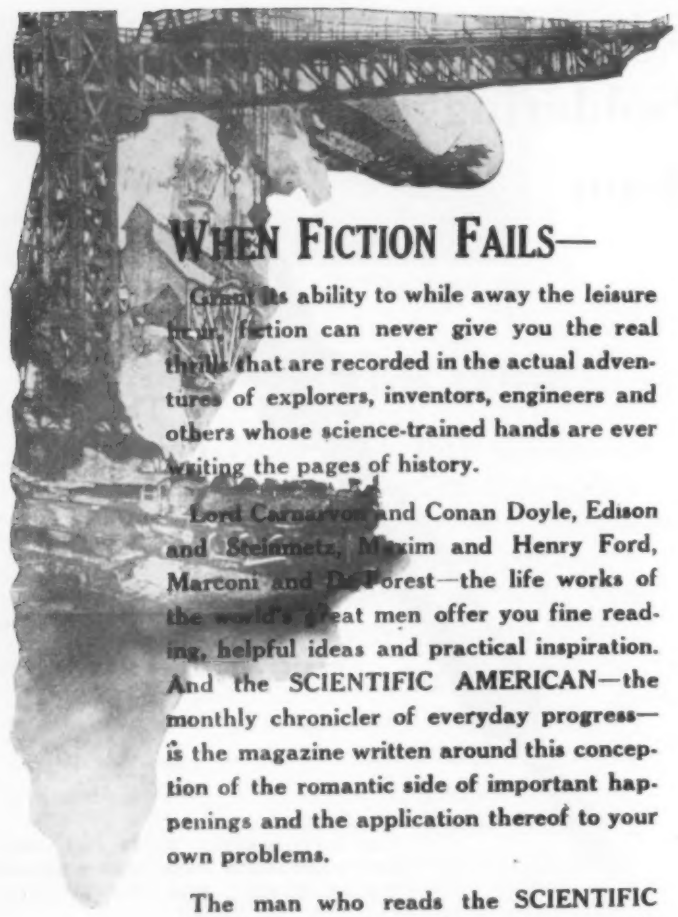

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Electrical Notes

A 1,000,000-Volt Transmission Line.—That a 1,000,000-volt transmission line is not altogether fantastic as far as its future application is concerned, is evidenced by the attention now being devoted to the subject by engineers. Recently two papers on the general subject were read before the American Society of Civil Engineers. The possibility of transmission at 1,000,000 volts has been considered and it is stated that it would be necessary to have a minimum of 100,000 kilowatts of power per circuit before transmission at this high voltage would be economically feasible, owing to the great cost of the lines and apparatus. Such transmission lines should have tubular conductors 6 inches in diameter, spaced 30 feet apart on 20-foot insulators on towers about 200 feet high. No doubt the limitations on the commercial use of higher voltages than those in operation at present will not be due to engineering difficulties, but rather to the location of the sources of, and markets for, the power.

An Electric Hammer of the hand type, which may be connected to the usual electric lamp socket or outlet has made its appearance. To any man or company whose business involves drilling or chipping masonry or chipping metal, or who has any use for a power hammer for light riveting on assembly work, the new electric hammer fills a long-felt want. It means that costly, tedious hand work on such operations can now be eliminated without the purchase and maintenance of heavy, expensive equipment. Any alternating current line furnishes the power. In brief, the power hammer is so convenient that it can be carried from place to place; so adaptable that it can be plugged into any ordinary light socket; so powerful that it will sink a hole one inch in diameter into hard concrete at the rate of three inches a minute; so simple that it cannot get out of order. It has but one moving part, the hardened steel hammer head, which flies back and forth in a cylinder. No motor, gears, cranks, eccentrics or connecting rods are included.

Electric Plowing in Europe.—From a recent issue of the *Electrical World* we learn of the extent of electric plowing in Europe. According to a survey recently made in Germany, for instance, the average yearly consumption for rural purposes is about 8.5 kilowatt-hours per acre of cultivated electrified area. Electric plowing of a field takes from 16 kilowatt-hours to 32 kilowatt-hours per acre. Thus if 80 per cent of the ground is electrically plowed each year, the adoption of electric plowing will increase the energy consumption per unit area to from two and a half to four times its present value. In Europe there are three radically different electric plowing systems in use, which may be called for simplicity, the French, German and Swedish systems. The French system, which has been developed among others by a Paris firm, makes use of a heavy motor wagon with two hoist drums, the plow being pulled back and forth by means of a long steel cable wound alternately on the two drums. The cable surrounds the field and has to be guided by two fixed drums and two other drums attached to anchoring wagons, one on each side of the field. In the German system, two separate motor wagons are employed, each with an 80-horsepower motor. These wagons move stepwise one on each side of the field and pull the plow back and forth between them. An alternative scheme is to use only one motor wagon, the other one being replaced by an anchoring car with a free drum to double the cable back. In the Swedish system there is a radical departure from former practice in electric plowing. A so-called "electrotank" or caterpillar electric tractor is used not only for plowing, but also for pulling harvesting machines and similar implements. For this reason the Swedish system seems better suited than the cable-pull to compete with the gasoline tractor. The electro tank carries a tall mast from which swings the aerial feeder, consisting of a flexible band of aluminum, built like a rope ladder, with the current-carrying cables kept apart by insulating spacers. The mast on the cable car is hollow and made of wood, the bare feeder being carried down through the mast to an insulating drum, where it is rolled up in such a way that each phase coils concentrically on itself and no short circuits can occur. The drum automatically pays out the flexible feeder as the tank moves away from the cable car, the feeder always being kept taut by an automatic regulating device built on the slip-clutch principle and driven by a small induction motor.

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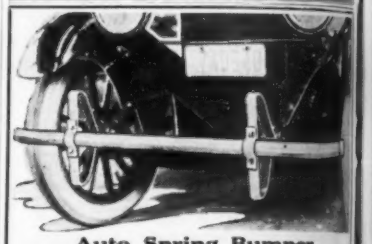

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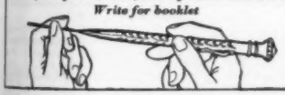

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Electrical Notes

The Identification of Wires and Cables is an important consideration. Just as certain rope manufacturers resort to various colored yarns and other devices for identifying their respective ropes—otherwise all ropes look more or less alike—so do electric cable and wire manufacturers resort to some scheme for identifying their respective products. Generally, the wire manufacturer simply includes one or more colored threads in order to identify his products. A manufacturer of British cables is using a printed tape, carrying his name and other data, which is wrapped about the core.

The Danger in Fuse Plugs.—A much mooted question in electrical circles is whether fuse plugs should be sold to anyone, irrespective of their knowledge of electricity. It seems that fuse plugs in all capacities—all the way to 30 amperes and over—are being sold to anyone. The danger of using 30 ampere fuses in the ordinary house circuit is obvious. Fuses of that capacity can pass a large volume of electricity without "blowing," and there is danger of serious damage to house wiring and household electrical devices in the use of such heavy fuses. Certain stores, aware of this danger, have limited the sale of fuses to inexperienced persons, to capacities not exceeding 10 amperes.

The Electric Range is steadily growing in favor, although its application is limited to certain sections of the country where a low rate for electric current is in effect. In the East, where rates vary from 8 cents to 15 cents per kilowatt hour, the electric range is more or less out of the question because of its high operating cost. Recent improvements in electric ranges have done much to reduce their operating costs, however. Thus the size of the heating units has been reduced so that every bit of heat is concentrated on the bottom of the cooking vessel, eliminating any chance for waste heat and speeding up the cooking operations. By combining the fireless cooker idea with the electric heating unit, it has been possible to bring down the cost of electric cooking to well within the reach of the average household, even in districts where high current rates obtain.

Oil-Testing Set.—There has been developed an interesting oil-testing set for the small station where the amount of transformer oil to be cared for does not justify an elaborate equipment, or for the larger operating companies for routine testing of oil in transformers at substations and distant points. Because of its portability and ease of operation, the quality of oil in drums at the time transformers are being filled may be checked. This set may pay for itself the first time transformers are installed, by eliminating any drums of oil which may have collected water in transit and storage, thereby saving the expense of filtering all of the oil, which could easily be contaminated in this way. The device has an oil-testing cup, which contains the disk spark gap and the oil to be tested, as well as a step-up transformer so that it may be connected to any lighting circuit of 110 volts, 50 to 140 cycles.

Neon Glow-Discharge Lamps.—The recently developed neon glow-discharge lamps have certain remarkable characteristics, we learn from *The Electrician*. These lamps have been placed on the market in the first place as units of low candlepower, suitable for potentials from 200 to 250 volts, either alternating or direct current. They have, however, other fields of usefulness owing to the form of their volt-ampere characteristic, and the suddenness with which the glow discharge starts immediately a certain critical voltage is exceeded. It is understood that these lamps have already been used as a "safe" light for developing photographic plates, with a red filter, of course, to cut off the violet end of the spectrum. If the neon glow-discharge lamps can be obtained with a red glass bulb instead of clear glass they would probably be exceptionally "safe" for photographic purposes. Incidentally, they avoid the trouble due to serious heating, which is usually associated with electric lamps of the filament type. A neon glow-discharge lamp will glow when brought into a rapidly alternating electro-static field, so that such a lamp could be suspended near any radio frequency generator as a warning signal to indicate when the plant is generating electrical oscillations. The power absorbed under these conditions is almost infinitesimal.

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STRENGTH
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Specify Dayton Steel Truck Wheels

Science Notes

Fourth on the List.—The inhabitants of the Argentine are great meat eaters, then come the Australians and their neighbors the New Zealanders. We come fourth on the list. It seems the rule that the great meat-producing countries are the great meat consuming countries.

Taking the Danger Out of "Laughing Gas."—Professor A. B. Lockhart and Professor J. P. Carter of the University of Chicago announce the discovery of a new anaesthetic which eliminates the danger of pneumonia from the so-called "laughing gas" (nitrous oxide gas). Ethylene gas is the base. It does not affect the heart and does away with the danger of pneumonia and lung abcesses.

For Aerial Photoplay.—A new device for aerial photography has recently been brought out by a Milan concern. By this apparatus it is possible to obtain photographs at all heights and of large and inaccessible places. The plates are perfect in all details, planimetric and altimetric, as they are exposed continuously and automatically by the operator. One of the great advantages of this apparatus is that the plates can be changed in about five seconds during the flight, so it is possible to execute photographs in series—even photographs taken with different magazines.

Some Temperature.—A girl in Michigan has had an authenticated temperature of 114 degrees for over two weeks. The ordinary clinical thermometers were useless, so weather bureau thermometers were substituted to take the readings. A committee of the County Medical Association had verified the temperature readings as 114 degrees or better and reams of learned dissertations would have been forthcoming if one of the doctors had not had his suspicions aroused and peeked through the door while the patient was alone. It was found that a tiny hot water bottle was used to send the mercury up so the girl's columns of newspaper publicity passed into the discard.

Project Exciting Moving Pictures and Save Coal.—Exciting plays and motion pictures cause the bodily temperatures of audiences to rise and result in the throwing off of heat so that judicious theater owners utilize such plays as a substitute for fuel, according to a Boston professor of note who says that he had made actual tests on theater audiences in Boston playhouses, and asserts that many theater owners observing this phenomenon lowered their heat supply as acts approach "The End." Fat persons, according to Professor Miller, give much more heat than thin ones as well as greater moisture, which is also beneficial since the average theater atmosphere is rather dry.

Mushroom Growths Endanger Structures at Versailles.—On account of large mushrooms of the poisonous type known as Phellium cryptarium having elected to exist on the large wooden beams of the Versailles Château it is reported that the building is in danger and immediate repairs must be made if one wing is to be saved. Hereafter all windows are to be kept open for three hours daily in an attempt to exterminate the mushrooms, which it is said spread with great rapidity and eat their way right through the woodwork. Phellium cryptarium mushrooms, which hate fresh air and sunlight, were recently discovered in an old school house in Etampes where they caused the building to collapse.

Mineralogy for Dentists.—Geologists, mining and civil engineers, foresters, chemists and ceramists have found that a knowledge of mineralogy and crystallography to be useful. It is new, however, for the student of dentistry to acquire such knowledge but it has been put into the first year course in the College of Dental Surgery at the University of Michigan. Since the successful dentist must, among other things, be an expert observer, have good power of visualization, and possess manipulative skill to a marked degree, it is obvious that these qualities should be developed as early as possible in his course. It is also of great advantage to the student to learn early, preferably before he has begun the highly technical instruction, that he has at least average ability along the three lines indicated. This special course in mineralogy attempts first, to develop ability of keen observation and of accurate visualization, and second, to determine whether or not the student possesses mechanical or manipulative ability or sense, and third, to impart a comparatively large amount of valuable general and technical information.

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Rate for advertising in this section 15 cents per word, for each insertion, payable in advance. Minimum space acceptable, 20 words. Rate card giving discounts for number of insertions sent on request. Advertisements for insertion in the September issue should be in our office by July 20.

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CENTRAL-AMERICAN INTERNATIONAL ADVERTISING SERVICE. Consult us regarding your advertising problems in Central America. A. H. Garnier & Co., San Jose, Costa Rica.

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MANUFACTURERS on large scale and homeworkers wanted to manufacture metal toys and novelties. Barking Dogs, Wag Tail Pups, Wild Animals, Automobiles, Indians, Bird Whistles, Cowboys, Baseball Players, Cannon, Toy Soldiers, Statues of Liberty, Miniature Capitols, Bathing Girl Souvenirs and others. Unlimited possibilities. Guaranteed casting forms, complete outfit, furnished manufacturers from $5.00 up. No experience or tools necessary. Thousands made complete per hour. 1923 business starts now. We buy goods all year and pay high prices for finished goods. Cash on delivery. Contract orders placed with manufacturers. Special casting forms made to order. Catalog and information free. Correspondence invited only if you mean business. Metal Cast Products Co., 1696 Boston Road, New York.

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AUTOMOBILE owners, garagemen, mechanics, send today for free copy America's most popular motor magazine. Contains helpful articles on overhauling, repairing, ignition, carburetors, batteries, etc. Automobile Digest, 542 Butler Bldg., Cincinnati.

BOOKS

LIGHTS, COLORS, TONES—Nature's Finer Forces, including vibrations, electromagnetons, inventions, radio, coldlights; illustrated; 240 pages, postpaid, $2.00. Stevens Scientific Publishers, 35 Powell St., San Francisco, Cal.

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$50 WEEK, evenings, I made it; mail order business. Booklet for stamp tells how. Sample and plan, 25 cents. Free 12 articles worth $3. Ansell Scott, Cohoes, N. Y.

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Position Vacant
Draftsman familiar with patent work who can also do general drafting. State age, experience and salary expected. Box 147, Scientific American.

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GENUINE Indian made baskets, blankets, bead work, and wampum. Wholesale priced catalogue mailed free. Francis Gilham, Kelseyville, Calif.

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Science Notes

Transfusing Animal Blood Into Man.—Dr. Cruchet of Bordeaux has succeeded in 16 successful cases in transfusing animal blood into human beings. He used horses and sheep for his initial experiments.

Tons of Fish Smothered in Lake Under Thick Ice.—Tons of fish have been smothered in Glenmore Lake, Orange County, N. Y., by the ice, which covers the lake from shore to shore. The ice was more than two feet thick, and on this was a foot or more of snow. When a hole was cut through the ice thousands of dead fish came to the surface and were carried over the dam. Hundreds of live fish in search of air filled the holes which were cut.

Innocuous Metol.—It is well known that metol, which is one of the most popular of photographic developers, suffers from the grave disadvantage that if it is allowed to come into contact with the hands it may cause persistent and exceedingly irritable sores. A method of German origin, by the interaction of methylamine and hydroquinone, gave a very good preparation with extreme ease, but caused severe outbreaks of poisoning in both the laboratories and the works. The metol prepared by the Lapworth process proved to be quite innocuous.

Pathological Object Glasses.—An English firm of opticians are supplying a set of what they call "Pathological Sets of Object Glasses." These sets were primarily intended for the use of technical institutions where students are taught to recognize the ordinary optical defects of object glasses. The set consists of 12 object glasses, each mounted in a numbered cell. Each object glass can be screwed into the same fitting, and when in place the key number is concealed. The faults are artificially produced, except in the case of veins where veiny glass is selected for the purpose. The defects represented are as follows: 1. Under-correction for color. 2. Over-correction for color. 3. Under-correction for aberration. 4. Over-correction for aberration. 5. Coma-free type in which the so-called Sine condition is fulfilled. 6. Veins in the material. 7. Axial astigmatism. 8. Zones of aberration. 9. Axial coma. 10. Lenses incorrectly edged. 11. Lenses strained in the cell. 12. Correct.

Light Paint for Ship Bottoms.—Some interesting results have been obtained by J. Paul Visscher in his study of the fouling of ships' bottoms. These results indicate that the color of the paint used is an important factor in determining the amount of fouling. A series of plates painted with different colors were exposed in sea water at the Beaufort laboratory and the development of the growths was observed over a period of several months. These colors included white, black, yellow, red, green and blue. The results show clearly that there was much more fouling on the dark plates than on those with lighter colors. The results are apparently explained by the factor that at the time of attachment of the larvæ to these forms the organisms are negatively phototropic, that is, they tend to go away from the source of light. This experiment is in accord with observations made on the growth on ships' bottoms where the densest growths are found in regions least exposed to light.

Old Egyptian Water-Clocks.—Several ancient time-observations, such as the statement of the equality of day and night at the equinoxes, make it clear that some form of clock was employed. It is therefore interesting to note that casts of two Egyptian water-clocks have lately been presented by the Egyptian Government to the Science Museum, South Kensington. One, from Karnak, dates from the reign of Amenhotep III. (B. C. 1415-1380); the other, from Edfu, is of the Ptolemaic Epoch; in the former, time is measured by the uniform escape of the water; in the latter, by its uniform admission. In each case there are 12 different scales, corresponding to the length of the night or day in different months. Each of these scales is divided into 12 equal parts, showing that an "hour" was at first of variable length, being one-twelfth of the length of the day or night at the particular time of year. Claudius Ptolemy collected the observed times of the phases of a number of lunar eclipses these were used by several investigators, including Newcomb, Cowell and Fotheringham, in studies of the moon's secular acceleration. As the times were presumably observed with some such instruments as those now exhibited, their study is of some astronomical importance.

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Meeseco Short Center Belt Drive—150 H. P. from motor at 700 revolutions per minute to a duplex double acting air compressor at 140 revolutions per minute. Distance between centers of shafts 6 feet, 6 inches.

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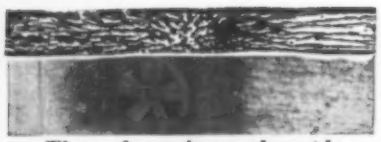

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Dings High Intensity MAGNETIC SEPARATION

Your Automobile and the Thief

(*Continued from page 417*)

transport of the changed vehicle to some point of disposal or shipping, proper concealment there and eventual sale under reasonably safe conditions, we shall see the subject more clearly.

An idea of the complexity to which automobile stealing has been developed by the better underworld organizations, the *haute pegre*, can be gained from the methods now in use in New York. They are much the same in other cities, from coast to coast.

A well-known automobile thief had been watching the owner of a new Cadillac sedan, who was in the habit of driving into the upper theatrical district and leaving his car at the curb for an hour or more in front of a building where he transacted business. On a Monday morning the thief watched his chance, saw that the car had not been locked, disappeared into the building after the car's owner, soon came out again, watched till the coast was clear, got into the sedan and drove away. He circled the block, ran rapidly north on Broadway, drew up at the curb near 120th Street, got out, crossed the street, took a taxi and returned immediately to the corner whence he had stolen the car. He was absent from this spot not more than 45 minutes and he returned to it so that he might be able to prove, in case suspicion rested on him, that he had been at the scene of the theft long after the car disappeared. On this circumstance, a jury would be almost certain to base a reasonable doubt in the thief's favor.

Meantime, a few moments after the first thief had left the stolen car at 120th Street, a second member of the gang appeared by careful prearrangement, got in and drove it north to the region of 200th Street, where there are many small private garages, mostly temporary sheet iron cages, put up in large groups by speculators, who rent them out by the month. The motor theft gangs have many under rental, and the second thief quickly ran the stolen car into one of these.

A little later a third man arrived, entered the garage with a key, changed the license plates on the stolen car, treated the more obvious identification numbers with acid, quickly stencilled new numbers into their places and then drove the car out of the garage and across town to a large public garage, which was, in fact, the receiving station of the gang. Here all the numbers known to the thieves were changed. The car was then repainted and changes were made in the upholstery. In this shape the stolen car was sent, some ten days later, to the establishment of a fence in a nearby Connecticut city.

The fence, after some weeks' delay, sold the car to a bootlegger running Scotch whiskey down from Canada. This man had the interior of the car rebuilt so that he might hide large quantities of bottled nepenthe in its interior and immediately set out for Canada for a load of contraband. He made several successful trips before the car was finally picked up by an insurance company detective, identified by the secret number and turned back to its owner.

It is a fact that at the present time a large number of high priced and high powered cars are being stolen especially for the bootlegging trade. These large cars are so altered internally that they will carry from 15 to 25 cases of Scotch. The bottles are taken from the cases and packed tightly under the seats and in the rear of the car in straw bottle protectors.

It may be of interest to know the makes of cars which are most often stolen today. They rank as follows: Ford, Dodge, Buick, Cadillac and Studebaker.

Motor stealing is not without its collateral romances. As in many other branches of crime, women and sex attraction play a large, a complex and often a sardonic, role. It is the habit of many gangs of the most accomplished motor thieves, in various cities, to employ young and handsome women, mainly recruited from the theatrical nether fringe, for the double purpose of getting information about owners of cars and luring incautious gentlemen into localities whence their cars may be stolen with practical impunity. A recent case sheds light enough to illumine the general idea.

Mr. John Doe, let us call him, peradventure, is a married man with an inherent weakness for forbidden gaieties. Like many another man of his type he allowed himself to be seen about restaurants and road houses when his spouse believed or pretended to believe that he was attending to those weighty and mysterious matters of business which apparently can only be transacted at night. Mr. Doe was soon the object of the attentions of motor thieves, for he invariably drove about in an expensive closed car.

One evening, Mr. Doe was allowed to feast his eyes upon an exceptionally handsome girl who did not repel his immediate and none too mannerly advances. She was often with him thereafter. He told her a good deal about himself and she apparently was equally confidential. When the acquaintance had progressed sufficiently far, he was permitted to suggest a trip to a roadhouse of shady reputation. The young woman consented to go.

While Doe and his handsome and mysterious lady were inside, the thieves appeared with a set of master keys, such as all the best gangs have now been able to smuggle out of leading automobile factories, unlocked his car and drove away. When Doe came forth and found what had happened there was consternation and much profanity; but the thieves were safe enough. Mr. Doe reported the loss of his car, one may be sure, but he was careful to conceal the locality from which it had been taken through fear of his wife. Instead of naming the roadhouse, he was compelled to insist that the car had been lifted from the street in front of his office, 20 miles away. Naturally, there was no successful pursuit or fruitful search. Such things happen nightly in every large city.

Alcohol and the Bootlegger

(*Continued from page 370*)

denatured alcohol that he wants. One or two examples of these formulæ will illustrate the significance of the above statement. The manufacturer of photoprints, photo enlargements, photo engravings, etc., requires grain alcohol in his manufacturing process. He is given an alcohol denatured with common ether, cadmium iodide and ammonium iodide. None of these substances will adversely effect the photoengravings that he makes with the aid of the alcohol; but on the other hand, these denaturing ingredients may have a decidedly beneficial effect. Grain alcohol is used in making vinegar, acetone and acetate of lime, and consequently, the vinegar contains denatured alcohol. The denatured alcohol that is used in making tooth paste contains glycerine and a good grade of toilet soap, or oil of peppermint, menthol, and citric acid, all of which substances do not impair the taste of the paste.

Responsible manufacturing concerns can secure alcohol, denatured by any of these formulæ, according to the requirements of their manufacturing processes and the necessary properties of the finished products. The ingredients that are added to the pure grain alcohol are all either violent poisons or substances which, while not exactly poisonous, nevertheless make the alcohol unpalatable and cause all sorts of disturbances of greater or lesser severity and danger to the stomach. It is not necessary for these substances to be present in large quantities in the denatured alcohol for them to exert their poisonous and injurious action.

It was almost inevitable that attempts would be made by bootleggers, unscrupulous manufacturers and chemists, persons with a smattering of chemical knowledge, to remove the denaturant from the alcohol and make intoxicants from the latter by coloring it with a little burnt sugar or caramel. But the nature and the properties of the substances that are used in the denaturing formulæ, are such that it is impossible to remove them in their entirety from the alcohol by any known chemical or physical processes. Drink made from such alcohol is dangerous and should be avoided as a vile poison. It should also be remembered that bootleggers, who are more unscrupulous than others of their ilk, will use denatured alcohol in making artificial whiskey and intoxicating drinks without attempting to remove the denaturant at all. Such drink is extremely dangerous and is really a most virulent poison.

The common denaturant of grain alcohol, wood alcohol, is particularly injurious. It has a most violent effect on the human system, producing severe stomachic pains, headache, blindness, delirium and finally death. Acetone, which is another common denaturant of alcohol, is also a bad poison, causing most serious disturbances in the human system. Isopropyl alcohol, still another denaturant, produces vomiting and severe pains in the stomach. And on through the entire list. There is not a single denaturant that does not have a very bad effect on the human system. The person who drinks bootleggers' concoctions is open to all these dangers, and the only sure way to avoid them, is to avoid the concoctions.

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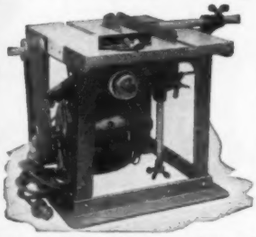

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Tearing Down to Build Again

(*Continued from page 373*)

norant of his highly valuable possession.

Other objects regarded as lumber are stairs, balusters and newelposts, ice-boxes, door-casings and trim. In one case the wrecker who sold a massive staircase from a Fifth Avenue mansion was later able to recognize the same article as a "property" in a motion picture, with Geraldine Farrar descending the steps.

The wrecker dislikes to buy new lumber because he cannot get its real worth on resale. A purchaser will not look in a place of this sort for new stuff and if it is offered to him will give only a very low price for it. This is due, of course, to the psychology of the second hand.

Junk includes many articles of far greater value than the name suggests. Such things as bathroom fixtures, pipefittings, I-beams, columns and bridle irons have fairly good values in many cases. In the case of I-beams, these may with care be salvaged in practically perfect condition, thus netting the wrecker a handsome return in cases where there is much steel to be removed. Salvaged iron that cannot be sold in its form at the time becomes scrap iron, and is divided into steel, wrought iron and cast iron. The cast iron is broken up with a maul into convenient sized pieces. All scrap is returned to the iron mill to be remelted.

From one job of wrecking, all the interior decorations for a small hotel in Florida were obtained. Electric generator sets are often left in large buildings when they are turned over to the wreckers. Such things as these help balance the cost of removing dirt or rubbish from a job. They are often sold to small municipalities.

In one case the wreckers took a job to tear down a house in one of the best parts of the city. This house had never had a savory reputation, and among other articles left by the owners was a statue of large size but doubtful modesty. The wreckers took vast pains to remove this statue intact, although it was very heavy. Carefully they edged it along towards a motor truck which was to take it away. Just as the statue, draped in a tarpaulin, was being run down the skids to the truck, a carelessly placed roller sleweed it off and as it fell it was broken into hundreds of fragments.

The Tower of Jewels of the Panama-Pacific Exposition was sold as it stood at the end of the exposition for $9000. From it the wreckers recovered 1800 tons of structural steel and 2,000,000 feet of lumber. The cost of dismantling was about $25,000 but the materials gained paid above this a handsome figure.

The ultimate consumer of all these commodities varies from the large engineering firm that buys all the heavy timbers in an old factory to the man who goes to the wrecker's yard to buy an old flagpole for his radio aerial. No sale is too large or too small. Lumber that cannot be used for any other purpose is sold for kindling wood. Articles may remain unsold during many years, yet however peculiar they are, someone always turns up to buy them. Many are the amusing experiences of the man in charge of the yard. His wits are sharpened by daily dealing with people who seek bargains and know how to drive them. But the buyer, regardless of his nationality, does not always win.

In one case a bearded person of shambling gait was seen from the office of the yard looking over a certain pile of joists. These joists were 16 feet long. When he had finished he passed into the street without apparent interest in the direction of the office. Thus he had won the first round, for the yard salesman was forced to recall him and ask him what he wanted. He deprecatingly replied that he wanted some 14-foot joists but saw only 16-foot ones in stock. After some haggling the salesman stated that he would sell him the lot he wanted as 14-foot lengths. Accordingly, after the purchaser had made full payment in advance, as required, and gone away, the 16-foot lengths were all cut off by two feet and delivered. On the following day the buyer was back, waving his hands wildly and moaning. He had wanted "those joists, as they were," as 14-foot lengths, and now that they were cut they were so short that they fell between the intended supports. But the salesman had known all the time what he was doing. He had not even wasted the two-foot lengths, for with his intimate knowledge of the market he knew of a foundation concern which was always in the market for such pieces to be used for blocking.

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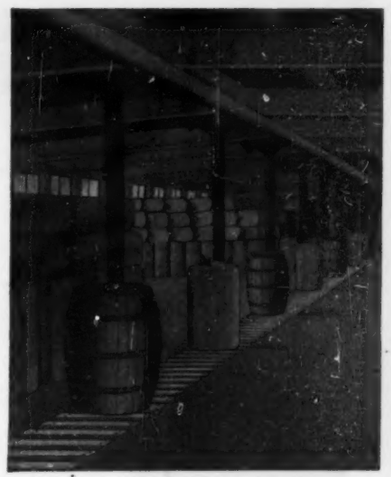

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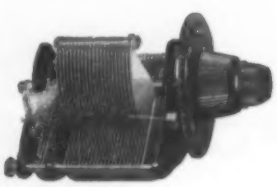

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Radio Notes

Summer Radio.—Just how well radio broadcasting fares during the coming summer remains to be seen. However, there are signs in plenty that it will not suffer to the extent which it did last summer, when the slump in radio activities was quite severe. Of course, it must be conceded that transmitting and receiving conditions are not as ideal in the summer time as in the winter, but this need not interfere with good reception from local stations. On April 1 of last year the number of broadcasting stations in operation in the United States numbered 137. This meant that large areas were left uncovered by a radio broadcasting service. Today the situation is entirely different, for there are over 600 stations in actual operation. These are so well distributed over the whole country that there is hardly one section that is not served by a nearby broadcasting station.

Attic Antennæ.—A radio salesman recently stopped in a certain rural community and although the local radio dealer seemed to be doing a flourishing business, hardly five outdoor antennæ were in evidence. Upon making inquiries, he was told that because of the lightning-fire fear on the part of many residents, he had advocated and personally installed the so-called attic antenna in dozens of houses. The psychological effect of having the antenna indoors had so reassured the people that he was advocating the same practice in nearby towns with marked success. For medium distance reception, it appears, the attic antenna is just as effective as the outdoor antenna, especially in detached frame houses. By virtue of its short span, it permits sharper tuning with consequent decrease of interference. Then too, the indoor antenna does not require elaborate insulation since it is never exposed to moisture or rain.

When Broadcasters Are No Longer Broadcasting.—In a recent issue of *Radio Service Bulletin*, operators of broadcasting stations are cautioned not to communicate with other stations. The transmission of acknowledgments to individuals relating to the receipt of letters, telegrams and telephone calls is direct communication and not authorized in the licenses of broadcasting stations. Section 2 of the act of August 13, 1912, states that the license of a station "shall state the purpose of the station," and as broadcasting stations are licensed for the specific service of broadcasting, any operator using a broadcasting station for point-to-point communication may have his license suspended or revoked in the discretion of the Secretary of Commerce. Owners of broadcasting stations should see that the above cited act is not violated, as the use of their stations for purposes other than specified in the station license is sufficient cause for the suspension or revocation of their station license.

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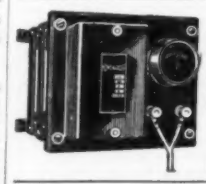

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DRY BATTERY
DETECTOR AND AMPLIFIER

SPECIFICATIONS

TYPE C-299

Filament potential . . . 3 volts
Filament current . . . .06 amp.
Plate potential . . . 20-80 volts
Mutual conductance . . . 327 micromhos at 40 volts plate and 0 grid potential

Price $6.50

Bulletin No. 2R describes this new tube in full and gives the necessary data regarding rheostats, battery voltages, transformers, etc. A free copy will be sent to you by return mail, upon receipt of your request at either of the addresses given below.

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Each Renewal Guaranteed for One Year

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This battery is similar in principle and voltage to the ordinary dry "B" battery. It contains enough water, however, to complete the chemical reactions involved and therefore it is far more efficient and will give longer life in proportion to its size than batteries of the dry type. Best for high voltage loud speaker installations. Best for ordinary broadcast reception. Best for DX. Remittances should include parcel post charges on 7 pounds. Circular on request. Dealers and agents, please write.

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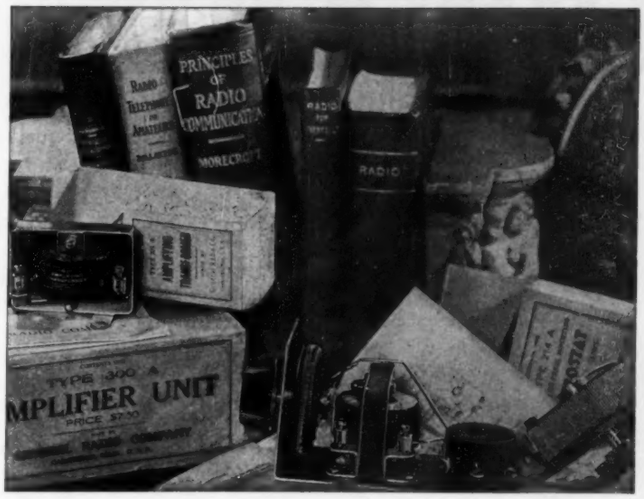
Radio Notes

The Donle Tube is a radically different tube which is now attracting the attention of advanced radio workers. It depends upon the ionization of metallic atoms for its operation, according to its inventor, H. P. Donle, chief engineer of the Connecticut Telephone and Electric Company. The tube is said to be remarkably sensitive, readily controllable and stable. The tube consists essentially of a filament, a semi-cylindrical electrode called a collector, and a metal anode composed of sodium or the like that can be readily ionized by heating with a resistor in series with the filament. A description of this tube has appeared in a recent issue of this journal.

The UV-199 Tube, although forming a part of certain receiving sets for some time past, has now been placed on the market for general sale. It is a very small tube, almost as small, indeed, as the famous peanut tube of Western Electric make. It has a special base and calls for a special socket. Both special socket and special adapter are now available. The UV-199 marks a most important advance in vacuum tube design. It operates on dry cells and has a filament current of only 60 milli-amperes—or, in other words, 60/1000 of an ampere, as compared with 1.1 ampere for the UV-200 and UV-201 tubes. The filament of the UV-199 requires three volts, and the usual small flashlight battery, comprising three cells, works very nicely in conjunction with a 30-ohm rheostat. The chief value of the new tube is in circuits where three or more tubes are required. The thoriated tungsten filament requires so little current for the emission of electrons that three or more tubes may be used at a time on a single set of three dry cells. In that event a 10-ohm rheostat is employed.

The Radiotron Family of Tubes now consists of the following: The UV-199 tube, the smallest member, described in another note appearing in these columns. The UV-200, which is a five-volt detector or "soft" tube, calling for critical adjustment of "B" battery potential, and requiring upwards of an ampere of filament current. The UV-201 is the running mate of the UV-200. However, it is a "hard" tube or amplifier tube, requiring 45 to 100 volts on the plate, and over one ampere at five volts in the filament. It is not critical. Then there is the UV-201-A, which is a combination detector and amplifier tube, operating with a filament voltage of five and a current consumption of 0.25 ampere. The UV-202 is a five-watt transmitting tube, also suitable as a power amplifier tube. The UV-203 is a 50-watt transmitting tube. The UV-204 is a 250-watt transmitting tube. The UV-206 is a one-kilowatt transmitting tube. The UV-208 is a five-kilowatt transmitting tube. The UV-207 is a 20-kilowatt transmitting tube of the new water-cooled tube; indeed, this tube is considerably smaller than the UV-208, although it has four times the capacity.

Several New Types of Vacuum Tubes have made their appearance on the market during the past few months. One of these is the new DeForest tube. It is an exceedingly neat piece of work, this new tube, with its compact horizontal plate and grid and filament enclosed in a straight-sided bulb which comes down flush with the usual standard base. The horizontal plate is made in the form of a cylinder; in fact, the whole tube resembles very much the tubes made by the Phillips firm in Holland. In practice the DeForest tube works very well, with a current consumption of about one-half ampere at 5 volts. The "B" voltage or plate potential can be anywhere from 22½ volts when used as a detector, to 45 volts or more as an amplifier. The DeForest tube is also made in a 1½-volt model as a dry-cell tube. In this case the filament is of the oxide-coated variety to give the necessary electronic emission at low filament temperatures. Still another tube just now is the UV 201 A, which has the same general shape and dimensions as the usual radiotrons. However, the glass is silvered so as to distinguish this tube from the usual radiotrons. It operates on six volts but instead of requiring somewhat over an ampere for the filament current, it consumes about one-quarter ampere. Such a tube, despite its considerably higher cost, is most welcome at this time when five and six tube sets are by no means uncommon. It now becomes possible to operate these multi-tube sets with no greater drain on the storage battery than would be the usual case with two tubes.



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Our Psychic Investigation in Europe—II

(*Continued from page 380*)

as to require activation before use; and this necessity he had met by standing, his back to the window and his hand behind his back, engaging us in conversation while he held the picture in the bright sunlight, for several minutes before his "sitting." When Hope sat with me he might have stood in the window all day, and he wouldn't have been able to expose anything to the sun's rays. There wasn't any sun in London on the afternoon of March 13; nothing but a miserable gray mist.

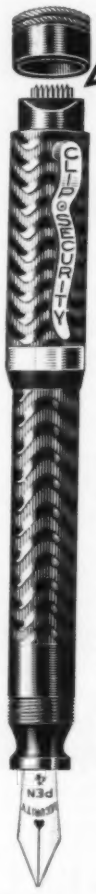
We made every effort to impress upon Father de Heredia that his trick had fallen quite flat, both in execution and in result; but we scored a complete failure. He went from our office to the editorial rooms of the *Herald*, and there gave an interview in which he stated that he had made a fake psychic picture for us; that he had duplicated Hope's success under identical conditions; that we had been completely at a loss; that I had admitted Hope's picture might have been made in this way and I should have been none the wiser. Concerning his intentions thus to deal with his results in our office he said nothing to us. The consequence was not merely that his interview was published without our having opportunity to object, criticize, comment or correct. In addition to this, in working with him in our dark room, we adopted the procedure which would have been suitable for a private and friendly experiment of the sort we supposed it to be, rather than that which would have been called for by a public test of our own shrewdness. If any doubt exists that sittings of these two classes are on a different basis, we point out merely that, after observing Father de Heredia's trick, we permitted him to go on instead of insisting categorically upon stopping the seance. It was quite in order for him to ask this and for us to grant it if the occasion were merely an informal examination of the possibilities of fraud; but if it were to be what Father de Heredia has tried to make of it, this was certainly not in order. In one respect at least, however, we are doing better by the good Father than he did by us: we are sending him, the moment we get it from the composing room, a proof of this article.

The most curious feature about all this is that Father de Heredia apparently believes that what he said was correct in every detail. He apparently believes that I am a person of such fatuity and ineptitude that when a psychic photographer puts his hands all over a plate in my presence, I either do not notice it, or do not recognize it as objectionable. He apparently believes that the SCIENTIFIC AMERICAN would have such a simpleton as this on its permanent staff, and would send him to Europe, without chaperon or keeper, to report upon the genuineness of psychic phenomena.

Among the reproaches which disbelievers in psychic phenomena lay at the door of believers, the most frequent are a complete insulation against unfavorable facts, and a complete lack of the sense of fair play. I speak neither as believer nor as disbeliever—it is not my habit to make up my mind in advance of a complete acquaintance with the facts. I speak merely, if I may quote Conan Doyle's characterization of me in a recent public talk, as one who seeks the facts, and is prepared to follow them wherever they may lead. In this capacity, I suggest that Father de Heredia's performance, outlined above, indicates most forcefully the extent to which the unbeliever's charges against the believer come home to roost.

When the SCIENTIFIC AMERICAN uses the term psychic, nothing is implied, as explained in previous issues, save that the phenomena to which this term is attached fall outside the possibility of explanation by accepted scientific doctrine. The spirit hypothesis is one of several which may then be advanced to cover them; upon it, or any of its alternatives, the SCIENTIFIC AMERICAN is far from ready to pass. With this precautionary statement, I will say that to me the probabilities seem good that the Hope picture about which this article revolves constitutes a genuine psychic phenomenon.

The critical mind is inclined to falter more at the psychic photograph than at psychic movement of material objects, or even at the psychic light. This, I am sure, is because consciously or unconsciously we balk at the idea that an object which made an impression on the plate could have escaped making an impression upon the eyes



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South Bend Bait Company 46

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of the sitters. But is this doing the subject justice? I do not think it is.

An effect may be produced upon the negative by photo-chemical action, as in the ordinary process of photography. Presumably a similar effect might be produced by chemical action under some other stimulus than that of light. Certainly a similar effect can be produced by actual physical action upon the grains of emulsion—I did it when I etched my name on the Hope plate with a pencil. We are inclined to grant, controversially at least, that there may be a force, as yet unformulated and unidentified, which is capable of moving material objects and perhaps also of producing luminous effects. Why do we so strongly hesitate to conceive this same force as affecting the photographic emulsion in either of the ways suggested, or in some other way that it does not occur to us to suggest? Why do we not realize that such a force might conceivably operate inside the camera or inside the package of plates, without any necessity for the presence, in the room, of an object that would reflect light into the camera in accordance with the conventional photographic technique? If this latter necessity ruled, it would be very pertinent to inquire how this object escapes the eye. But in the presence of the suggestions which I have thrown out, I should think that psychic photography is no more inherently improbable than any other psychic phenomenon of physical and objective character. I should think its occurrence might well be considered in the same breath with that of telekinesis, say, and of other phenomenon which are ordinarily regarded as a little bit more respectable than the psychic photograph.

Speeding Up Track Work

(*Continued from page 386*)

ond crane then follows laying the new steel for the second line.

After both rails have been laid and the centers spiked to gage, the ties which support the joints are adzed to a one-to-twenty cant, or inward slope, to correspond to the cant of the tie plates and the rail joints placed in position, where they are held by one bolt. The insulated joints are next put in and completely bolted up by one or two men who do nothing else but this work.

The mechanical equipment for drilling the bond-wire holes in the ends of the rails is next in line. This usually consists of an air-compressor unit to which are attached four air drills. This unit is sometimes pushed by hand, in which case the work progresses one rail length at a time. In other instances, it is coupled up between two railway motor cars having free-running engines and clutch control, with a distance of approximately 25 feet between the motor cars and the air compressor. Air is supplied to the drills through about 80 feet of ¾-inch pipe mounted above the air compressor and supported at each motor car by two uprights. Short lengths of hose furnish the connections to the four air drills, each of which handles one joint or a total of three rail lengths at a time. With the completion of the drilling, the drills are suspended on hooks provided for that purpose and the outfit moved ahead under its own power. The motor car operators distribute the bond wires as the unit moves along. This power layout is followed by a track motor car and two trailers carrying tool grinders and extra tools. Where only one crane is used this car transports the gangs back and forth to the start as soon as each unit finishes.

The final or closing work is performed by a series of gangs varying from two men up to 30 or 40, who straighten out the tie plates, bolt up the joints, gage the rail, drive all spikes, clear out for and install rail anchors to prevent creeping and install the bond wires and signal connections. Where pneumatic wrenches are used, it is possible to reduce the force by about 20 to 25 men, six men on the pneumatic wrenches usually replacing about 30 bolting up by hand. The equipment for this work consists of an air compressor, connected up with a motor car, to which either two to four air-operated wrenches are attached by hoses. Two wrenches are used on a joint, each of the operators taking care of one side or three nuts at each joint. The machines rest on the ties, which take up the force of reaction of turning up the nuts. A man is assigned to each pair of air hoses and it is his duty to see that these lines are kept from being fouled by motor car when the unit is moved forward. The time for this work has proved remarkably short, averaging in actual practice only about 30 seconds from the finishing

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Butte is one of America's rich cities. Its resources are limitless.

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Butte has a population of approximately 55,000, many fine buildings and some very large stores. Its altitude is 5,500 feet, which means that the atmosphere has a "snap and sparkle" to it which you do not find in cities nearer sea-level. The approach to Butte via the Northern Pacific Railway—particularly at night, when the city is ablaze with electric lights—is one of the most notable experiences of the trans-continental journey.

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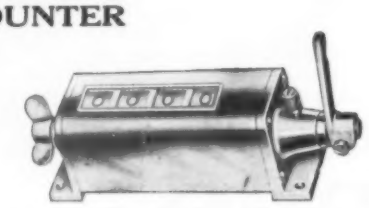

This large **Set-Back Rotary Ratchet Counter** records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50. (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra

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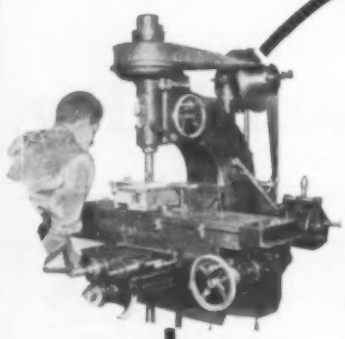

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up of one rail to the finishing up of the next.

In summary, the results obtained by this method of laying rail have been quite satisfactory to both the operating and maintenance-of-way departments. Where two cranes are used, from five to six miles of track are generally relaid during an ordinary working day, and to the satisfaction of this railroad it has been found that the operation of trains over a single track section of this length has not caused any appreciable delay or attendant expense. It has been possible to lay and complete a much longer piece of track by this method with a much smaller number of men, than would be possible by other methods, and with the present wage schedules this saving in men is a factor of prime importance. Another saving which has resulted from the use of mechanical equipment is the reduction in the number of drills necessary for drilling bond-wire holes. In one instance, 730 holes were drilled with four drills in operation, at the rate of 203 holes per hour with only six replacements, two of which were the results of accidents. Considering that the average number of holes bored per drill is usually about 14 by the hand method, the saving which has been effected in this item alone, is self-evident. Still another result which is of interest is the strong spirit of competition which has been developed between the individual units of the organization because of the elimination of the drudgery. From the start in the morning to the finish in the afternoon, each unit seems to be endeavoring constantly to see how hard it can crowd on the heels of the one ahead.

Getting Our Money's Worth in Fertilizer

(Continued from page 393)

material prevents many cities from installing sanitary garbage disposal plants. At this writing there are at least a dozen garbage reduction plants which have had to store an excellent grade of garbage tankage until their warehouses are literally bulging, and this in spite of the fact that the product is offered at a price of about one-fifth that of commercial fertilizers.

To the layman this seems an almost incredible situation. Here is a product which contains in a concentrated form (it takes about five tons of raw garbage to produce one ton of tankage) food values which have been taken from the land. The essential food elements are all present in the correct proportion required for further plant growth. To meet any special condition the farmer himself could mix in with the tankage on his barn floor any further chemicals he desires. The fertilizer is in a form in which a small part of the plant food will be immediately available and the remainder will add to the soil fertility through decay—an ideal condition. Further, it has been shown that nitrogen in the form of ammonia unites with other chemical elements in the soil, and although available for plant food, it is not easily washed away by heavy rains.

The writer has before him two letters. One is from a scientist in the U. S. Department of Agriculture which verifies many of the statements made above, and the other is from a Connecticut farmer, in which appears the following statement:

"I was particularly interested in the use of garbage tankage but particularly ignorant of the results. Therefore when we planted potatoes I personally put in two rows about 600 feet long. I used the tankage sparingly in the bottom of the rows, putting a layer of earth over it and then the potato seed. I did the same with peas. I wish to say to you that I never saw such peas or potatoes grow as those fertilized in the above manner. The potato vines were a different shade of green from the rest of the field and grew to such enormous size and so rapidly that I thought they were going to be all vine and no potatoes. As nearly as I can remember I dug the first hill about the first of August and I was astounded at the size of the potatoes. . . . This year I am going to use all the tankage I can lay my hands on."

This is not an isolated instance, but an experience common to many farmers who have tried this material. One farmer now buys several carloads each spring, which he distributes among his neighbors. Various experiments at agricultural stations have demonstrated beyond a doubt that this material has a far greater fertilizing value than chemical analysis under present standards indicates.

In some instances garbage reduction plants have attempted to sell their product direct to farmers in the vicinity of the plant, an arrangement desirable from every point of view. But the farmers always have first to be weaned away from established methods and then taught to use the garbage tankage for maximum results—a very slow process and usually not a successful one.

Most of the plant food value carried to the city which is not wasted as garbage, is wasted as sewage, and there is the promise that modern sewage disposal methods will yield a product equal in importance to garbage tankage. In fact, sewage sludge, as it is called, has a higher ammonia content than tankage. It is only lately that some of the problems that have held up this development have been solved, and although only a small amount of dried sewage sludge is produced now, several plants are under construction which will yield considerable amounts.

There is one other great potential source of fertilizer filler which is coming into use. This is peat. Peat is the organic residuum from the arrested decomposition of leaves, twigs, roots, trunks of trees, shrubs, moss and other vegetation in low areas which are continually saturated or covered with water. It may be roughly identified as the dark colored soil in bogs and swamps sometimes called muck.

Peat differs from ordinary soils in that it is composed entirely of organic matter in a state of partial decomposition. When taken from the bog, dried, treated and transferred to other soil, the rate of decomposition is accelerated so that plant food which has been locked up in it perhaps for centuries, is released within a short period.

Peat has the disadvantage that it has to be thoroughly treated before it is useful as fertilizer. Usually an acid condition has to be corrected when it is taken from the bog and it contains strains of harmful bacteria which must be killed by sterilization. After this treatment cultures of useful bacteria are usually added and the material is seasoned and dried before shipping.

On an average, the ammonia content of peat is not as high as that of tankage, usually running about two per cent. But here and there is a peat deposit which contains four or five per cent ammonia and it is these which will be useful for fertilizer. The potential importance of this material may be realized from the fact that there are in the United States some 12,000 square miles of peat beds, estimated as capable of yielding fourteen billions of tons of dried, prepared peat. Canada has an even larger supply, with about 37,000 square miles of deposits.

It is interesting to note in reviewing these possible sources of organic fertilizers, that for nearly a century, beginning early in the nineteenth century, the world derived nearly all of its fertilizers from great deposits of "guano" found on an island off the coast of Chili, and later found on other South Sea Islands. These deposits were the excrement accumulated through many centuries of great flocks of sea birds at their breeding places. These deposits are now exhausted, but records shows that the fertilizing value was about the same as a good grade of modern tankage.

By some freak of nature about the only known great deposits of nitrates are those in Chili. Aside from substituting the organic nitrogen in part for the foreign mineral product, there is no large domestic supply in sight. Lately the country has been very much exercised over the proposal of Mr. Henry Ford to operate the great government nitrate plant at Muscle Shoals, Ala., for the production of fertilizer. It is significant, however, that this great plant for the atmospheric fixation of nitrogen by electricity was never operated commercially and engineers seriously doubt if nitrates could be produced there cheaply enough to compete with the Chilean natural product.

The situation as regards potash is more hopeful, but again it is doubtful whether any manufactured product will ever be able to compete with the product of the great natural deposits in Europe, even though the latter must be shipped half way around the globe. During the war when the European supply was shut off, a number of enterprises for securing a domestic supply of potash were got under way. These included drying and processing kelp, a giant seaweed growing in abundance on the coast of California; evaporating the briny waters of some of our western salt lakes and extracting other minerals to leave the potash salts; treating the "green sands" of New Jersey and Delaware for potash; and the electrolytical precipitation of potash in the stacks of cement mills, blast furnaces and similar plants using limestone. But most of these enterprises have had to be abandoned.

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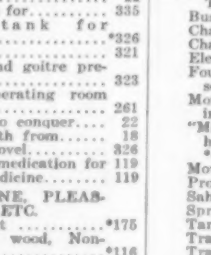

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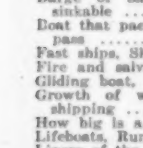

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Advantages and Disadvantages of the Concrete House

IN a recent number of *Concrete*, Mr. J. C. Pearson, Chief of Cement Section, United States Bureau of Standards, discusses the advantages and disadvantages of the all-concrete house, by which he means a house that has its structural walls, floors and main bearing partitions of concrete, regardless of other materials which may be used in the exterior or interior finish. The outstanding advantages of such a house are stated to be as follows:

1. It is more sanitary than any other type, affording less opportunity for vermin to find thoroughfare or breeding and hiding places.

2. It is a very fire-resistive type of construction.

3. Its maintenance and depreciation are low.

4. It is of maximum stability and rigidity.

These advantages are fairly self-evident. No comment is necessary on the first, nor on the second, other than to mention the regrettable fact that people are so indifferent to fire risk. Fire-resistive construction in dwelling houses is inseparably a part of the new order of building; in the all-concrete house there is the highest degree of fire resistance.

It is fairly well established that a proper maintenance and depreciation allowance for frame houses is about 5 per cent per annum of the total cost. An all-concrete house, we are led to believe, can be built at a cost not greater than 15 to 20 per cent above that of a frame house on substantially the same plans, and the maintenance and depreciation allowance on this type is estimated at about 2.5 per cent.

The fourth argument for the concrete house, maximum rigidity and stability, is a most important one, for these are the qualities upon which low maintenance and depreciation depend. Rigidity and stability of the frame do more than this, however, for they not only tend to preserve the house in its original condition, but they save the house owner and housekeeper from continual worry about the unsightly appearance of cracks in the plastering, the separation of baseboards from floors, the annoyance of sticking and non-latching doors, sags and humps in floors, and other ills of like nature.

The arguments against the concrete house are stated as follows:

1. Prevalence of opinion that the concrete house is likely to be cold, damp or unattractive in appearance.
2. Higher first cost.
3. Building code restrictions.
4. Lack of builders who are interested or experienced in this type of construction.

The first of these objections is valid only to the extent that one may be unfavorably impressed by certain existing examples of concrete housing.

The second of these objections, higher first cost, is unfortunately too often the deciding factor in the building or purchase of a home. It has been shown, however, that the additional expense entailed in building a concrete house is a wise investment, as it means a saving in the end and always carries advantages in the nature of a direct return. The higher first cost is not, therefore, a valid argument against the concrete house, for it is the justifiably higher price of a better product.

One-Eyed Jobs

IN many occupations it is necessary for the workman to make use of a magnifying glass, if not during the whole time, at least when engaged upon the more delicate portions of the work. Most of the lenses employed are single, so that these jobs are said to be "one-eyed" jobs. The one-lensed magnifying glass employed is called a "micros." The result of this constant use of one eye alone has been studied by Dr. E. Berger of Berne, Switzerland.

Writing in a recent issue of *Natur und Technik* he says that the natural supposition would be that only the eye employed at the lens would suffer from such work. However, it has quite recently been established that it is the other eye which is injured the most by this one-sided work, so that eventually even when both eyes are used the retina of the usually idle eye fails to respond, which is attributed to a sort of psychological influence. In fact the unused eye may even become crossed. This is especially the case when the unused eye is kept open.

Swiss watchmakers are in the habit of trying to avoid these evil effects of the use of one eye by exercising the eyes with a stereoscope. Dr. Berger has constructed a binocular lens to be employed in such crafts which it is hoped will enable workmen whose eyes have not already been injured to keep them in good condition.

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